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ORIGINAL RESEARCH

Preoperative Lactate Dehydrogenase-to-Albumin Ratio and Overall Survival in Gastric Cancer: Stage-Specific Prognostic Implications

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Objective: To evaluate the prognostic value of the preoperative serum lactate dehydrogenase-to-albumin ratio (LAR) in patients with gastric cancer (GC), with a focus on its stage-specific implications for overall survival (OS).

Methods: This single-center retrospective cohort study included 568 patients with resected GC. Patients were categorized into low-LAR and high-LAR groups for comparative analysis. The baseline characteristics, short-term postoperative outcomes, and OS were compared between the two groups. Cox proportional hazards regression was performed to identify the independent risk factors for OS. Kaplan–Meier analysis was used to assess OS across tumor stages in the two LAR groups.

Results: In total, 568 patients were enrolled. Patients in the high-LAR group were older and had a lower body mass index (BMI), while also showing higher preoperative lactate dehydrogenase level, lower albumin level, and a greater number of retrieved lymph nodes. Univariate and multivariate analyses indicated that BMI was independently associated with a favorable OS. Tumor stage and preoperative neoadjuvant treatment were identified as independent adverse prognostic factors for OS. However, LAR was not independently associated with OS in the entire cohort. The unadjusted Kaplan–Meier analysis showed that patients in the high-LAR group had poorer OS in the overall cohort and in stage II GC, indicating a potential stage-specific prognostic relevance of LAR.

Conclusion: Preoperative LAR was not an independent prognostic factor for overall OS in the GC cohort. However, exploratory analyses suggested potential stage-specific prognostic relevance, particularly in stage II GC. Further large-scale prospective studies are required to validate these findings.

Keywords: gastric cancer, LAR, prognosis, risk factors, overall survival

Introduction

Gastric cancer (GC) remains a leading cause of cancer-related morbidity and mortality worldwide, with a particularly high disease burden in China.[1–4] For patients with resectable GC, radical gastrectomy with digestive tract reconstruction,[5,6] including Billroth I reconstruction (B-I), Billroth II reconstruction (B-II), and Roux-en-Y reconstruction (R-Y),[7–9] remains the principal curative treatment. However, postoperative outcomes vary substantially among patients, suggesting that prognosis is influenced by both tumor- and host-related factors.[10–12]

Systemic inflammation, tumor metabolism, and nutritional status are closely involved in GC progression.[13–15] Lactate dehydrogenase (LDH), a key enzyme in glycolytic activity and hypoxia adaptation,[16,17] has been associated with poor prognosis across multiple malignancies.[18–22] Serum albumin is a marker of nutritional and inflammatory status, and hypoalbuminemia has been linked to adverse outcomes in patients with gastrointestinal malignancies.[23–25] Accordingly, the lactate dehydrogenase-to-albumin ratio (LAR), which integrates information on both tumor metabolism and host nutritional-inflammatory status, may provide a more comprehensive prognostic assessment than either marker alone. As both biomarkers are inexpensive and routinely available,[26] LAR has the potential for incorporation into preoperative risk stratification. By identifying patients at increased risk of adverse outcomes, LAR may help guide patient management, including closer perioperative monitoring, more intensive supportive care, and more individualized treatment plans.

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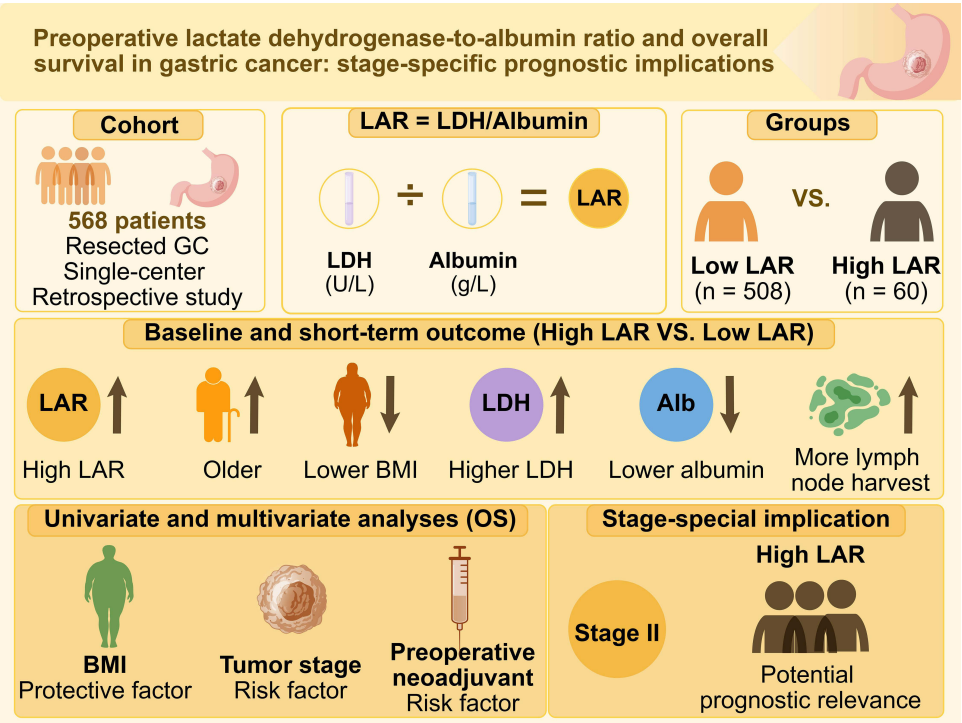
Graphical Abstract



Although LAR has demonstrated prognostic value in several malignancies,[26–30] its significance in GC remains unclear. A previous single-center study by Aday U et al[31] reported no significant association between LAR and survival in patients with GC; however, it was limited by its small sample size and single-center design, which may have reduced its ability to detect prognostic heterogeneity across disease stages. In particular, it remains uncertain whether preoperative LAR is an independent predictor of overall survival (OS) in patients with GC and whether its prognostic value varies according to tumor stage. Moreover, because LAR reflects both tumor metabolic activity and host nutritional/inflammatory status, it may be associated with short-term postoperative outcomes that are clinically important for perioperative decision-making and early recovery evaluation. Therefore, a larger-scale study is warranted to comprehensively re-evaluate the prognostic significance of LAR in GC, including its stage-specific association with OS and its relationship with early postoperative outcomes. Such an investigation would address important methodological limitations of previous studies rather than simply replicating the previous findings. From a clinical perspective, this evidence may improve preoperative risk stratification, optimize prognostic assessment, and support individualized treatment planning.

Therefore, the present study aimed to investigate the prognostic value of preoperative LAR in patients with GC and determine whether it independently predicts OS and early surgical outcomes, with particular emphasis on its potential stage-specific prognostic significance.

Methods

Patients and Eligibility Parameters

Patients with histologically confirmed GC who underwent surgical treatment at a tertiary institution between June 2018 and June 2022 were consecutively enrolled. Eligible patients were required to have a diagnosis of GC and to have undergone gastrectomy with intestinal reconstruction. A total of 643 patients were initially identified. Patients were excluded for the following reasons: non-R0 resection (n = 23), residual GC (n = 12), coexisting malignancies (n = 9), and insufficient clinical data (n = 31). Finally, 568 patients with GC who underwent gastrectomy were included in the final retrospective cohort.

Ethical approval was obtained from the Ethics Committee of Chongqing Medical University First Affiliated Hospital (2022-K206), and informed consent was obtained from all participants. All procedures were conducted in accordance with the ethical principles of Helsinki.

Data Extraction and Study Design

Demographic and clinical characteristics of the GC included demographic characteristics (age, gender, body mass index [BMI]), lifestyle factors (tobacco use, alcohol consumption), laboratory indices (hemoglobin, LDH, albumin, LAR), and surgical treatment-related factors (preoperative neoadjuvant intervention, procedure type, type of digestive tract reconstruction and tumor stage). Short-term outcomes included operative variables (operative duration, hemorrhagic volume, lymph node harvest), postoperative recovery indicators (length of hospitalization), and postoperative morbidity (any-grade and severe postoperative morbidity). The operative interventions included total gastrectomy (TG) and subtotal gastrectomy (SG). Gastrointestinal continuity was restored using Billroth I, Billroth II, or Roux-en-Y anastomotic techniques. Data were collected from the medical record and via telephone follow-ups.

The optimal cutoff value for LAR was determined using X-tile and determined to be 12.8. Patients were subsequently categorized into low-ratio (LAR < 12.8) and elevated-ratio (LAR ≥ 12.8) cohorts. Lymph node involvement in the tumor was assessed using the AJCC 8th Staging Manual.[32] Postoperative complications were graded using the Clavien–Dindo classification,[33] with severe adverse events defined as those of grade III or higher. OS was defined as the interval between the date of surgery to the date of death or the last follow-up. The survival follow-up cutoff date was November 2025. Patients who were alive at the last follow-up or were lost to follow-up for any reason were censored. Lost-to-follow-up patients were censored at their last known alive time point.

Statistical Analysis

Continuous variables are presented as the mean ± standard deviation (SD). An independent-sample *t*-test was conducted to analyze the differences between the low and high LAR groups. Categorical variables are presented as n (%), with differences between the low and high LAR groups assessed using the chi-square test or Fisher's exact test. Cox regression analysis was used to identify the variables that were independent predictors of OS. Univariate analysis was performed for all variables to identify those independently associated with OS. Variables with $P < 0.05$ in univariate analysis were subsequently entered into multivariable Cox regression. The results are reported as the hazard ratio (HR), along with the corresponding 95% confidence interval (CI). The Kaplan–Meier method was used to estimate OS, and compare OS across various tumor stages between the two groups. Analyses stratified by tumor stage were performed only for exploratory purposes. As these analyses were conducted post hoc, no adjustments for multiple comparisons were applied. To assess the stability of the LAR cutoff (12.8) identified by X-tile, 10-fold cross-validation was performed. The dataset was randomly divided into 10 subsets. In each fold, the optimal cutoff was re-determined on the training set (9/10 of the data). The mean and SD of these 10 cutoff values were calculated. Furthermore, sensitivity analyses were performed to evaluate whether the prognostic effect of LAR was dependent on a specific cutoff. Alternative stratification methods included dichotomization based on the median LAR value and categorization based on the upper and lower tertiles of LAR. Kaplan–Meier curves and Log rank tests were performed for these alternative cutoff values. Statistical analyses were performed using R software (version 4.5). P value < 0.05 was considered statistically significant.

Results

Baseline Parameters

A total of 568 patients who underwent radical gastrectomy at a tertiary institution were included in the study (Figure 1). The average age of the cohort was 60.9 ± 10.7 years. Of the 568 participants, 401 (70.6%) were male and 167 (29.4%) were female. The mean LDH level was 338.0 ± 398.7 (U/L), the mean albumin level was 40.0 ± 6.2 (g/L), and the mean LAR was 8.8 ± 11.4. Additional baseline data, including BMI, tobacco use, alcohol consumption, hypertension, preoperative neoadjuvant intervention, procedure type, tumor stage, operation duration, hemorrhagic volume, type of digestive tract reconstruction, lymph node harvest, length of hospitalization, and both any-grade and severe postoperative morbidities were presented in Table 1.

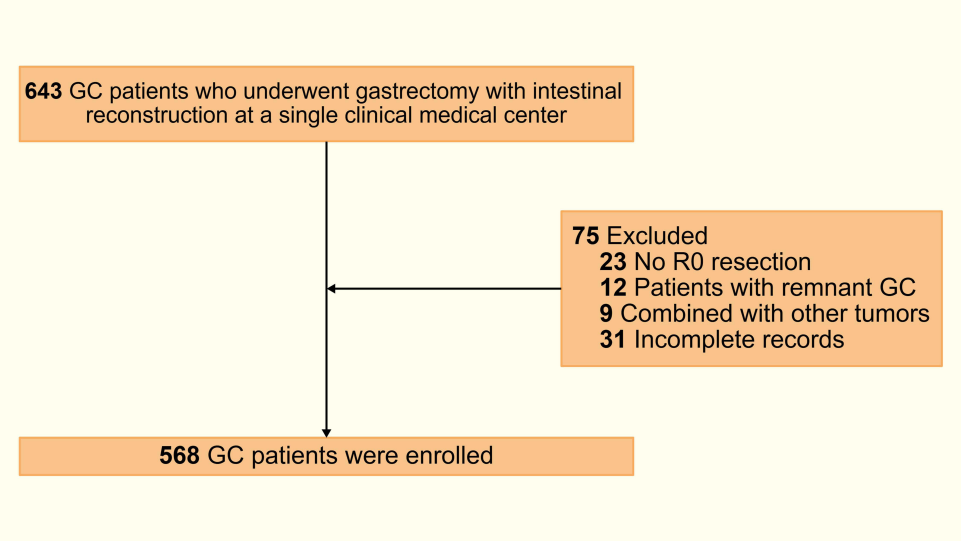


Figure 1 Flow chart of patient selection.

Comparison of Baseline Parameters Stratified by LAR Groups

Patients in the high LAR group were significantly older ($P < 0.01$), and had a lower BMI ($P = 0.042$), higher LDH and lower albumin levels (both $P < 0.01$). No statistically significant differences were observed between the low and high LAR groups in terms of gender, tobacco use, alcohol consumption, hypertension, preoperative neoadjuvant intervention, procedure type, tumor stage, or type of digestive tract reconstruction ($P > 0.05$) (Table 2).

Table 1 Baseline Information of the Included Patients

Characteristics	N (Total = 568)	(%)
Age, year	60.9 ± 10.7	
Gender		
Male	401	(70.6%)
Female	167	(29.4%)
BMI, kg/m^2	22.1 ± 3.2	
Tobacco use	270	(47.5%)
Alcohol consumption	186	(32.7%)
Hypertension	96	(16.9%)
Neoadjuvant intervention	38	(6.7%)
LDH, U/L	338.0 ± 398.7	
Albumin, g/L	40.0 ± 6.2	
LAR	8.8 ± 11.4	
Procedure type		
TG	172	(30.3%)
SG	396	(69.7%)
Tumor stage		
I	174	(30.6%)
II	103	(18.1%)
III	291	(51.2%)
Operative duration, min	217.7 ± 70.0	
Hemorrhagic volume, mL	172.6 ± 287.9	

(*Continued*)

Table 1 (Continued).

Characteristics	N (Total = 568)	(%)
Type of digestive tract reconstruction		
B-I	260	(45.8%)
B-II	114	(20.1%)
R-Y	194	(34.2%)
Lymph node harvest	21.9 ± 9.3	
Length of hospitalization, day	12.9 ± 7.9	
Any-grade postoperative morbidity	166	(29.2%)
Severe postoperative morbidity	19	(3.3%)

Note: Variables are expressed as the mean± SD, n (%).
Abbreviations: BMI, Body mass index; LDH, Lactate dehydrogenase; LAR, Lactate dehydrogenase-to-albumin ratio; TG, Total gastrectomy; SG, Subtotal gastrectomy; B-I, Billroth I reconstruction; B-II, Billroth II reconstruction; R-Y, Roux-en-Y reconstruction.

Table 2 Contrast Analysis of the Low and High LAR Cohorts

Characteristics	Low LAR (Total = 508)	High LAR (Total = 60)	P value
Age, year	60.3 ± 10.6	65.5 ± 10.3	<0.01*
Gender			0.549
Male	361 (71.1%)	40 (66.7%)	
Female	147 (28.9%)	20 (33.3%)	
BMI, kg/m^2	22.2 ± 3.1	21.3 ± 3.3	0.023*
Tobacco use	242 (47.6%)	27 (45.0%)	0.785
Alcohol consumption	165 (32.5%)	21 (35.0%)	0.771
Hypertension	84 (16.5%)	12 (20.0%)	0.470
Neoadjuvant intervention	31 (6.1%)	7 (11.7%)	0.105
LDH, U/L	298.1 ± 124.0	675.2 ± 1125.4	<0.01*
Albumin, g/L	40.7 ± 5.9	33.6 ± 5.2	<0.01*
LAR	7.4 ± 3.1	19.9 ± 31.9	<0.01*
Procedure type			0.298
TG	150 (29.5%)	22 (36.7%)	
SG	358 (70.5%)	38 (63.3%)	
Tumor stage			0.142
I	162 (31.9%)	12 (20.0%)	
II	92 (18.1%)	11 (18.3%)	
III	254 (50.0%)	37 (61.7%)	
Type of digestive tract reconstruction			0.332
B-I	232 (45.7%)	28 (46.7%)	
B-II	106 (20.9%)	8 (13.3%)	
R-Y	170 (33.5%)	24 (40.0%)	

Note: Variables are expressed as the mean ± SD, n (%), *P value <0.05.
Abbreviations: LDH, Lactate dehydrogenase; LAR, Lactate dehydrogenase-to-albumin ratio; BMI, Body mass index; TG, Total gastrectomy; SG, Subtotal gastrectomy; B-I, Billroth I reconstruction; B-II, Billroth II reconstruction; R-Y, Roux-en-Y reconstruction.

Comparison of Short-Term Outcomes Between Dichotomized LAR Groups

Between-group comparisons encompassed short-term prognosis metrics: operative duration, hemorrhagic volume, lymph node harvest, length of hospitalization, and postoperative morbidity (any-grade and severe). The high LAR group had a significantly higher total number of lymph node harvest than those in the low LAR group (P = 0.038). Table 3 provided detailed comparisons, with no statistically significant differences in any other characteristics (all P > 0.05).

Table 3 Contrast Analysis of Short-Term Prognosis Metrics Stratified by LAR Ratio Status

Characteristics	Low LAR (Total =508)	High LAR (Total =60)	P value
Operation duration (minutes)	216.8 ± 71.6	225.2 ± 55.2	0.174
Hemorrhagic volume (mL)	166.0 ± 289.0	229.1 ± 275.2	0.099
Lymph node harvest	21.6 ± 9.3	24.3 ± 9.1	0.038*
Length of hospitalization (days)	12.8 ± 8.0	13.5 ± 7.0	0.505
Any-grade postoperative morbidity	147 (28.9%)	19 (31.7%)	0.655
Severe postoperative morbidity	19 (3.7%)	0 (0%)	0.246

Note: Variables are expressed as the mean ± SD, n (%), *P value <0.05.
Abbreviation: LAR, Lactate dehydrogenase-to-albumin ratio.

Follow-Up and Survival Outcomes

The median follow-up period was 26 months, with a range of 1 to 87 months. By the end of follow-up, 151 (26.6%) patients had died, and 417 (73.4%) patients were censored. Among the censored patients, 255 (61.2%) were still alive at the last follow-up assessment. A total of 162 patients were lost to follow-up, representing 28.5% of the total cohort and 38.8% of censored patients. These patients were censored at the date they were last known to be alive according to the predefined follow-up protocol.

Single- and Multi-Predictor Cox Regressions for OS

Cox regression analyses were performed to identify risk factors associated with OS. The variables included demographic factors (age, gender, BMI), lifestyle variables (tobacco use, alcohol consumption), clinical characteristics (hypertension, neoadjuvant status, tumor stage, LAR status), operative parameters (procedure type, type of digestive tract reconstruction), and postoperative morbidity. The univariate analysis revealed that age (HR 1.016 [95% CI 1.001–1.032]; P = 0.035), BMI (HR 0.915 [95% CI 0.866–0.966]; P < 0.01), preoperative neoadjuvant intervention (HR 2.786 [95% CI 1.738–4.466]; P < 0.01), tumor stage (HR 2.542 [95% CI 1.977–3.268]; P < 0.01), procedure type (HR 0.392 [95% CI 0.284–0.540]; P < 0.01), type of digestive tract reconstruction (HR 1.637 [95% CI 1.366–1.963]; P < 0.01), LAR (HR 1.952 [95% CI 1.270–3.000]; P < 0.01), and postoperative morbidity (HR 1.622 [95% CI 1.171–2.245]; P < 0.01) were significantly associated with OS. No significant associations were observed for the remaining variables. Multivariate analysis further revealed that BMI remained an independent protective factor for OS (HR, 0.934 [95% CI: 0.882–0.989]; P = 0.019), whereas preoperative neoadjuvant intervention and tumor stage emerged as independent risk factors (HRs, 2.614 and 2.121, respectively; both P < 0.01). Although LAR was significantly associated with poorer OS in univariate analysis, it did not retain independent predictive value after multivariable adjustment (HR 1.372 [95% CI 0.873–2.158]; P = 0.171) (Table 4).

Table 4 Single and Multi-Predictor Cox Regression for OS

Risk Factors	Univariate Analysis		Multivariate Analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
Age (years)	1.016 (1.001–1.032)	0.035*	1.006 (0.990–1.022)	0.460
Gender (male/female)	1.021 (0.718–1.451)	0.908		
BMI (kg/m^2)	0.915 (0.866–0.966)	<0.01*	0.934 (0.882–0.989)	0.019*
Neoadjuvant intervention (yes/no)	2.786 (1.738–4.466)	<0.01*	2.614 (1.608–4.247)	<0.01*
Tumor stage (III/II/I)	2.542 (1.977–3.268)	<0.01*	2.121 (1.632–2.757)	<0.01*
Tobacco use (yes/no)	1.066 (0.774–1.468)	0.695		
Alcohol consumption (yes/no)	1.200 (0.863–1.670)	0.279		
Hypertension (yes/no)	1.239 (0.811–1.893)	0.321		
Procedure type (TG/SG)	0.392 (0.284–0.540)	<0.01*	0.459 (0.165–1.277)	0.136
LAR (high/low)	1.952 (1.270–3.000)	<0.01*	1.372 (0.873–2.158)	0.171

(*Continued*)

Table 4 (Continued).

Risk Factors	Univariate Analysis		Multivariate Analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
Type of digestive tract reconstruction (R-Y/B-II/B-I)	1.637 (1.366–1.963)	<0.01*	1.230 (0.867–1.746)	0.246
Any-grade postoperative morbidity (yes/no)	1.622 (1.171–2.245)	<0.01*	1.322 (0.949–1.840)	0.099

Note: *P value <0.05.
Abbreviations: HR, hazard ratio; CI, confidence interval; LAR, lactate dehydrogenase-to-albumin ratio; BMI, body mass index; TG, total gastrectomy; SG, subtotal gastrectomy; B-I, Billroth I reconstruction; B-II, Billroth II reconstruction; R-Y, Roux-en-Y reconstruction.

Tumor Stage-Specific Kaplan–Meier Survival Curves

Using the unadjusted Kaplan–Meier method to calculate OS across various tumor stages for both LAR-defined cohorts, the high LAR group exhibited significantly poorer OS in entire cohort or tumor stage II (Figure 2a and c; both P < 0.01). No significant differences in OS were observed between LAR strata in either stage I (Figure 2b) or stage III (Figure 2d)

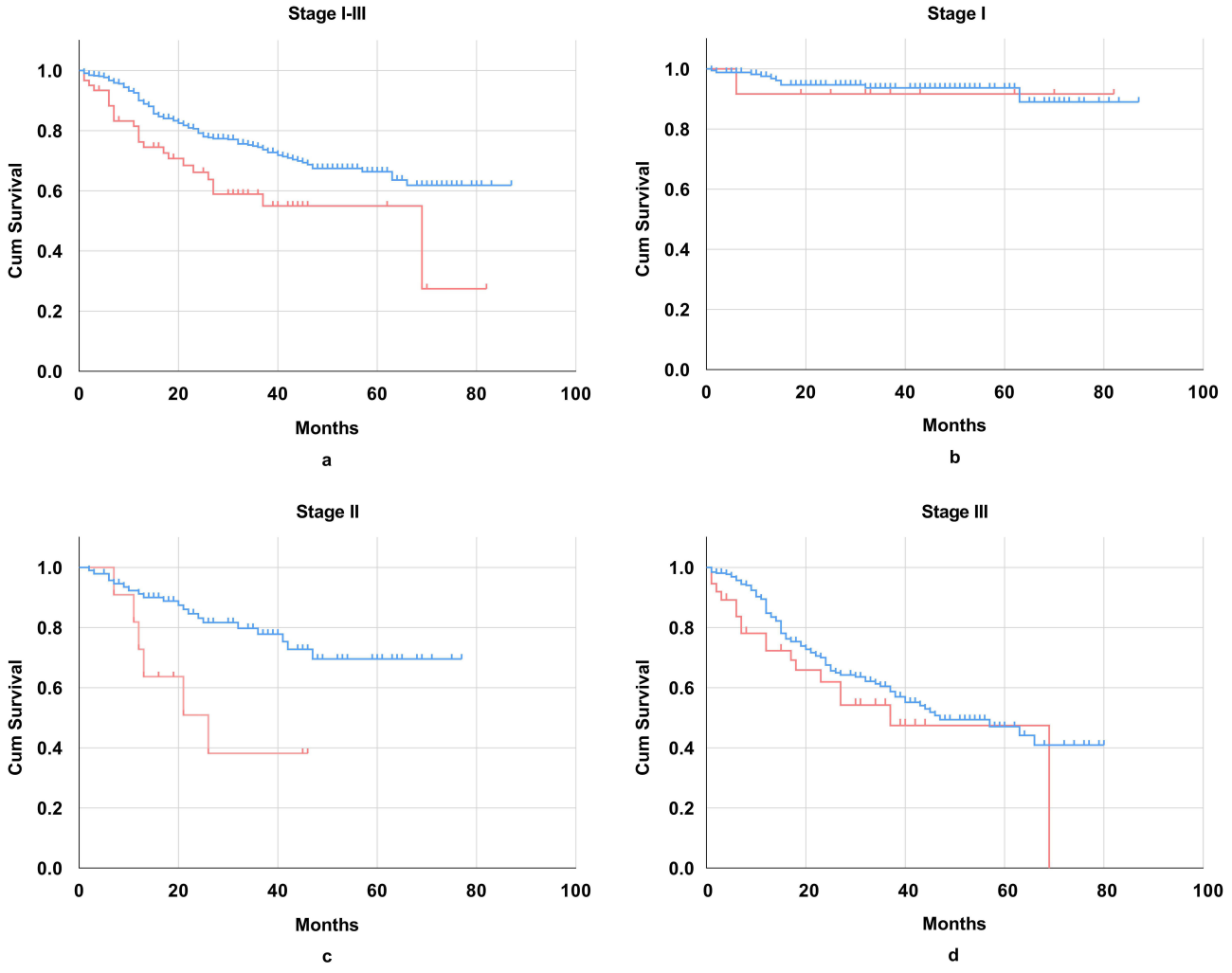


Figure 2 Unadjusted OS curves after gastrectomy stratified by LAR status. (**a**) OS curves stratified by LAR status in the entire cohort; (**b**) OS curves stratified by LAR status among patients with tumor stage I; (**c**) OS curves stratified by LAR status among patients with tumor stage II; (**d**) OS curves stratified by LAR status among patients with tumor stage III.
Notes: Red denotes the high LAR cohort; blue indicates the low LAR cohort. These survival analyses are exploratory and presented for descriptive purposes only. The apparent separation of curves, particularly in stage II disease, should be interpreted cautiously and not considered evidence of a stronger independent effect without confirmation from multivariable analyses.
Abbreviations: OS, overall survival; LAR, lactate dehydrogenase-to-albumin ratio.

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(both P > 0.05). To our knowledge, the finding has not been reported in any other studies. However, given the relatively smaller number of patients in the high-LAR group, it should be interpreted cautiously as a hypothesis-generating, being exploratory in nature, and requires independent validation.

Validation of the LAR Cutoff

The 10-fold cross-validation demonstrated excellent stability of the X-tile-derived cutoff (12.8), yielding a mean optimal cutoff of 12.91 (SD = 0.094) (Figure S1). The Kaplan–Meier survival curves using the original cutoff (12.8) and the cross-validation mean cutoff (12.91) were nearly identical. In the sensitivity analysis, the median LAR (8.69) and the upper and lower tertiles (9.91 vs. 6.57) failed to produce a statistically significant survival discrimination (log-rank P = 0.312 and P = 0.237, respectively), in contrast to the significant result obtained with the original cutoff, demonstrating the optimality of the X-tile-derived cutoff (Figure S2).

Discussion

Following the application of a cutoff value of 12.8, 568 eligible patients from a single academic center were categorized into low- and high-LAR groups. In the present study, BMI emerged as an independent protective factor for OS, whereas preoperative neoadjuvant intervention and tumor stage were independent risk factors for OS. Although LAR was associated with OS in univariate analysis, it did not retain independent prognostic significance in the multivariate analysis. These findings suggest that LAR may partly reflect the patient's underlying condition or disease burden; however, its prognostic value remains limited.

We acknowledge that LAR is a composite index derived from two well-established biomarkers, LDH and albumin, and therefore does not represent methodological innovation per se. The principal contribution of this study was to evaluate the clinical utility of LAR as a practical prognostic indicator in GC, particularly in stage II disease where its discriminative value was more pronounced. LAR remains clinically attractive because it is derived from two routinely indicators and can be available easily at no additional cost.

Previous studies have reported the prognostic value of the LAR in several malignancies. Gan and Peng demonstrated that LAR was an independent prognostic biomarker following curative resection of hepatocellular and nasopharyngeal carcinomas.[27,28] Similar prognostic associations have also been observed in colorectal cancer and esophageal squamous cell carcinoma.[26,29,30] Some studies have reported that LAR outperformed tumor node metastasis staging in predicting OS and disease-free survival (DFS).[30] However, these findings cannot be directly extrapolated to GC because tumor biology, treatment strategies, and stage distributions differ substantially across cancer types. Moreover, even within GC, the existing evidence remains limited and heterogeneous. In a small study of 81 patients, Aday U et al[31] reported a non-significant trend toward poorer survival in patients with elevated LAR. Although our study included a substantially larger cohort, we similarly found that LAR was not an independent prognostic factor in the multivariate analysis. Differences in sample size, cutoff selection, patient characteristics, including stage distribution, and other unmeasured confounders, may partly account for the inconsistent findings across studies. Meanwhile, with respect to short-term surgical outcomes, LAR did not demonstrate a clear clinically meaningful effect in the overall cohort. The only notable difference was observed in the lymph node harvest, whereas the other perioperative outcomes were not significant. Therefore, our results suggest that the prognostic utility of LAR in GC should be interpreted with caution. The prognostic or diagnostic value of the studied parameters may not be universal across all clinical contexts, underscoring the need for larger prospective studies with standardized thresholds and more balanced stage distributions.

The Kaplan–Meier analysis demonstrated poorer OS among patients with stage II GC in the high-LAR group; however, these curves were unadjusted and should not be interpreted in isolation. These findings were post-hoc and exploratory. Therefore, no adjustment for multiple comparisons was performed, and the result should be interpreted as hypothesis-generating rather than confirmatory, warranting further validation. It should be interpreted with caution as the multivariate analysis of the overall cohort did not support this result. One possible explanation is that LAR may capture a composite of inflammatory status and nutritional status that is more relevant in stage II patients with GC.[34–37] However, given the exploratory and post hoc nature of this finding, caution is warranted when interpreting its biological significance. Therefore, these observations should be considered hypothesis generating and require validation in larger prospective cohorts.

In contrast, preoperative neoadjuvant intervention and tumor stage remained independently associated with OS, findings that are consistent with the established clinical evidence.[38–40] Neoadjuvant treatment is typically administered to patients with more advanced disease, and tumor stage is a well-established determinant of prognosis in GC.[41] These variables may also be associated with systemic inflammatory and nutritional parameters, which could influence laboratory markers such as LDH and albumin.[42] However, in the present study, these relationships should be interpreted as associative rather than causal, since LAR itself was not an independent predictor of OS.

This study has several limitations. First, its retrospective design renders it inherently prone to selection bias and confounding factors. Owing to the retrospective nature of the study, some of the omitted confounding markers were unavailable. Second, this was a single-center study, which may have limited the generalizability of the results. Finally, only preoperative LAR was analyzed, and dynamic changes in LDH and albumin levels during treatment were not assessed. Therefore, large-scale prospective studies with longer follow-up periods and external validation are required to clarify the prognostic value of LAR in GC.

Conclusion

Preoperative LAR was not an independent prognostic factor for OS in the entire GC cohort in the multivariate analysis. Nonetheless, the analysis suggested that LAR may have stage-specific prognostic implications, especially in patients with stage II GC. These findings should be considered exploratory and interpreted cautiously that requires further validation in larger, prospective studies.

Abbreviations

GC: Gastric cancer; B-I: Billroth I reconstruction; B-II: Billroth II reconstruction; R-Y: Roux-en-Y reconstruction; LDH: Lactate dehydrogenase; LAR: Lactate dehydrogenase-to-albumin ratio; OS: Overall survival; BMI: Body mass index; TG: Total gastrectomy; SG: Subtotal gastrectomy; SD: Standard deviation; HR: Hazard ratio; CI: Confidence interval; DFS: Disease-free survival.

Data Sharing Statement

Data are available on request from the authors.

Ethics Approval and Consent to Participate

Approval for the study was obtained from the relevant ethics committee of Chongqing Medical University First Affiliated Hospital (2022-K206), and informed consent was obtained from all participants. The study adhered to the ethical standards promulgated by the principles of Helsinki.

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Author Contributions

YYS and YHD contributed to the overall conception and design of the study, investigated the research background, and formulated the research objectives, study framework, and research ideas. YYS, YHD, YC, and CT discussed and determined the inclusion and exclusion criteria and participated in the acquisition, collection, screening, and organization of the research data. YYS and YHD performed the data analysis and interpretation and contributed to drawing the main conclusions of this study. YYS and CT drafted the initial manuscript. YHD critically revised the manuscript for important content. YC contributed to quality assessment of the research process and results and supervised the overall progress of the study.

DLD made a significant contribution during the revision of the manuscript. He provided critical suggestions regarding the clinical implications of the study, helped further clarify the novelty and clinical relevance of the findings, and offered valuable advice on strengthening the Discussion section, particularly regarding the limitations of the present study. He also assisted in rechecking and verifying the data during the data review process.

KQL contributed to critical revision of the manuscript. He helped improve the structure, organization, logical flow, scholarly presentation, and clarity of expressions in the manuscript. He also assisted in refining the wording and presentation of the revised manuscript to ensure that the revised version addressed the concerns raised by the editor and reviewers more clearly, coherently, and professionally. His contributions went beyond language polishing and meaningfully improved the readability, coherence, academic rigor, and overall quality of this manuscript.

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

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Disclosure

Youyun Shi and Yuhang Diao are co-first authors for this study. The authors declare that they have no competing financial interests or personal relationships that influenced this study.

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