ORIGINAL ARTICLE

DOI: 10.37047/jos.galenos.2026.2026-5-2

J Oncol Sci 2026;12(2):317-324

Pretreatment Hemoglobin, Albumin, Lymphocyte, and Platelet Score Predicts Pathological Response and Postoperative Pathological Findings in Locally Advanced Gastric Cancer

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ABSTRACT

Objective: The hemoglobin, albumin, lymphocyte, and platelet (HALP) score has been extensively studied as a prognostic biomarker in various malignancies; however, its predictive value for pathological response to neoadjuvant chemotherapy remains unclear. This study aimed to evaluate the association between the pretreatment HALP score and tumor regression grade (TRG) in patients with locally advanced gastric cancer (LAGC).

Material and Methods: This retrospective single-center study included 65 patients with histologically confirmed LAGC who received neoadjuvant fluorouracil, leucovorin, oxaliplatin, and docetaxel chemotherapy followed by curative-intent surgery. The HALP score was calculated using baseline laboratory parameters obtained prior to treatment initiation. Pathological response was assessed using the Mandard TRG system. Receiver operating characteristic (ROC) analysis was used to determine the optimal HALP cut-off value. Logistic regression analysis was performed to identify predictors of treatment response.

Results: Among the 65 patients, 34 (52.3%) were classified as good responders and 31 (47.7%) as poor responders. The HALP score was significantly higher in good responders (46.3±25.1 vs. 30.8±20.0; p=0.006). ROC analysis demonstrated moderate discriminatory ability [area under the curve: 0.700; 95% confidence interval (CI): 0.570-0.830; p=0.006], with an optimal cut-off value of 38.6. Low HALP scores were significantly associated with poor response (p=0.001) and with more advanced pathological stages. In logistic regression analysis, HALP was the only significant predictor of treatment response (odds ratio: 0.16; 95% CI: 0.05-0.49; p=0.001).

Conclusion: The pretreatment HALP score is significantly associated with pathological response to neoadjuvant chemotherapy in LAGC. As a simple and accessible biomarker, HALP may aid in pre-treatment risk stratification and treatment decision-making. Prospective validation is warranted.

Keywords: Gastric cancer; neoadjuvant therapy; tumor regression grade; biomarkers; inflammation; nutritional status

INTRODUCTION

Gastric cancer (GC) remains the fifth most commonly diagnosed malignancy worldwide and the fifth leading cause of cancer-related mortality, with more than 968,000 new cases and approximately 660,000 deaths reported in 2022.[1] A substantial proportion of patients present with locally advanced disease at diagnosis, contributing to the persistently poor prognosis of gastric adenocarcinoma. Although the addition of perioperative systemic therapy to curative-intent gastrectomy has significantly improved survival outcomes, treatment response remains markedly heterogeneous among patients.[2]

Perioperative chemotherapy has long been a cornerstone of standard treatment for locally advanced GC (LAGC). In recent

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Received: 15.05.2026 **Accepted:** 24.08.2026 **Publication Date:** 31.08.2026

Cite this article as: Kutlu Ö, Gül G, Günenç Eşim D, Argon A, Taşkaynatan H, Özdemir Ö. Pretreatment hemoglobin, albumin, lymphocyte, and platelet score predicts pathological response and postoperative pathological findings in locally advanced gastric cancer. J Oncol Sci. 2026;12(2):317-324

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years, the incorporation of immune checkpoint inhibitors into perioperative treatment strategies has been associated with improved pathological response rates and event-free survival.[3-5] However, the integration of chemoimmunotherapy into routine clinical practice varies by country, reimbursement policy, and patient subgroup. Therefore, chemotherapy-based neoadjuvant approaches continue to play an important role in many clinical settings. Patients achieving pathological complete response after neoadjuvant therapy have consistently demonstrated significantly better survival outcomes compared with those with partial or no response.[6] Accordingly, pathological response following neoadjuvant therapy is considered not only a treatment endpoint but also a strong prognostic indicator.

Despite its clinical importance, reliable, easily accessible, and cost-effective biomarkers that predict which patients are more likely to benefit from neoadjuvant treatment remain limited in routine clinical practice. In recent years, the impact of nutritional status and systemic inflammation on cancer biology, treatment response, and survival outcomes has become increasingly recognized.[7] In this context, the hemoglobin, albumin, lymphocyte, and platelet (HALP) score has been proposed as a composite biomarker reflecting the host's immunonutritional status. The HALP score was first introduced by Chen et al.[8] as a novel prognostic index for predicting postoperative survival in patients with GC. Subsequently, a large meta-analysis demonstrated that a low pretreatment HALP score was consistently associated with poorer survival outcomes across multiple cancer types.[9]

However, the existing literature on the HALP score has largely focused on its prognostic value in relation to survival outcomes, while its potential role as a predictor of treatment response has not been sufficiently investigated. In particular, data evaluating the association between HALP and tumor regression grade (TRG), an objective and standardized measure of pathological response following neoadjuvant therapy, remain scarce.[10-12] Given that TRG not only reflects treatment efficacy but is also closely associated with long-term oncological outcomes, identifying biomarkers that predict TRG prior to treatment is of considerable clinical relevance.

In the present study, we aimed to evaluate the predictive value of the baseline HALP score for pathological response to neoadjuvant fluorouracil, leucovorin, oxaliplatin, and docetaxel (FLOT) chemotherapy in patients with LAGC. Specifically, we investigated the association of HALP with TRG and with postoperative pathological features to determine whether HALP may serve as a practical tool for pre-treatment risk stratification.

MATERIAL AND METHODS

Study Design and Patient Population

This retrospective single-center study included 65 patients with histologically confirmed locally advanced gastric adenocarcinoma who received four cycles of neoadjuvant FLOT chemotherapy at a tertiary referral center and subsequently underwent curative-intent gastrectomy between November 2023 and March 2025.

Locally advanced stage was defined as clinical stage ≥cT2 and/or positive regional lymph nodes (cN+) without evidence of distant metastasis, according to the 8th edition of the American Joint Committee on Cancer staging system. Clinical staging was established using contrast-enhanced computed tomography (CT) and/or magnetic resonance imaging of the chest, abdomen, and pelvis and endoscopic ultrasonography. Diagnostic staging laparoscopy with peritoneal cytology was not routinely performed before initiation of neoadjuvant chemotherapy. Treatment decisions were based on conventional clinical staging using contrast-enhanced imaging and endoscopic ultrasonography.

Patients whose baseline CT images were not available at the time of diagnosis, whose imaging quality was not adequate for staging evaluation, or in whom metastatic disease was detected intraoperatively were excluded from the study.

Patients were included if postoperative pathology reports, including TRG, were available for evaluation. Surgical procedures were performed at either University of Health Sciences Türkiye, İzmir City Hospital or external centers, provided that complete postoperative pathology reports were accessible for review.

Patients were excluded if baseline laboratory parameters required for HALP score calculation were not available within 7 days before initiation of neoadjuvant chemotherapy, if postoperative pathological response data were not available, or if they did not complete the planned four cycles of neoadjuvant FLOT chemotherapy prior to surgery.

The present study is a predefined subgroup analysis of patients receiving neoadjuvant FLOT chemotherapy within a larger retrospective cohort of patients with LAGC treated at our institution.

Ethical Approval

The study was approved by the University of Health Sciences Türkiye, İzmir City Hospital Non-Interventional Clinical Research Ethics Committee (approval number: 2025/297, date: 18.06.2025) and was conducted in accordance with the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for individual informed consent was

waived. However, written informed consent for the use of clinical and pathological data for research purposes had been obtained from patients at the time of treatment according to institutional policy.

Treatment Protocol

All patients received four cycles of neoadjuvant FLOT chemotherapy prior to surgery. The FLOT regimen consisted of FLOT administered according to standard institutional protocols. Curative-intent gastrectomy with appropriate lymph node dissection was performed following completion of neoadjuvant treatment.

Laboratory Parameters and HALP Score Calculation

Baseline laboratory parameters used to calculate the HALP score were obtained within 7 days prior to the initiation of the first cycle of neoadjuvant chemotherapy. Laboratory values obtained after initiation of chemotherapy were not considered for analysis.

The HALP score was calculated using the following formula:

HALP = [hemoglobin (g/L)× albumin (g/L)× lymphocyte count (×109/L)] / platelet count (×109/L)

Pathological Response Assessment

Pathological response to neoadjuvant treatment was evaluated using the Mandard TRG system. TRG 1 indicates complete regression with no residual tumor cells; TRG 2 indicates rare residual tumor cells scattered through fibrosis; TRG 3 indicates residual tumor cells with fibrosis still predominating; TRG 4 indicates residual tumor outgrowing fibrosis; and TRG 5 indicates absence of regressive changes. For response analysis, patients were dichotomized into good responders (TRG 1-3) and poor responders (TRG 4-5) consistent with previously published studies evaluating pathological response following neoadjuvant therapy in GC.

Data Collection

Clinical, laboratory, and pathological data were retrospectively retrieved from electronic medical records. Collected variables included demographic characteristics, clinicopathological features, baseline laboratory parameters prior to neoadjuvant chemotherapy, treatment details, and postoperative pathological response findings.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics software (version 26.0; IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as mean ± standard deviation and median (interquartile range, if appropriate), while categorical variables were presented as frequencies and percentages. The normality of continuous variables was assessed using the Shapiro-Wilk test. As most continuous variables were not normally distributed, comparisons between groups were performed using the Mann-Whitney U test. Categorical variables were compared using the χ^2 test or Fisher's exact test, as appropriate.

The predictive performance of the HALP score for treatment response was evaluated using receiver operating characteristic (ROC) curve analysis. The area under the curve (AUC) and the corresponding 95% confidence intervals (CIs) were calculated. The optimal cut-off value for the HALP score was determined using the Youden index.

Patients were categorized into two groups based on the optimal HALP cut-off value, and subgroup comparisons were performed accordingly. Associations between HALP groups and clinicopathological variables, including TRG, ypT stage, ypN stage, lymphovascular invasion, and perineural invasion, were analyzed.

To identify predictors of treatment response, univariable logistic regression analysis was performed. Variables with potential clinical relevance, including HALP score, clinical T stage, clinical nodal status, histological subtype, and signet-ring cell component, were included in the model. Odds ratios (ORs) and 95% CIs were calculated. To assess the internal robustness of the logistic regression model, bootstrap resampling with 1,000 samples was performed and bias-corrected and accelerated (BCa) 95% CIs were calculated. A two-sided p-value of <0.05 was considered statistically significant.

RESULTS

A total of 65 patients with LAGC were included in the analysis, of whom 34 (52.3%) were classified as good responders (TRG 1-3) and 31 (47.7%) as poor responders (TRG 4-5). The median age of the study population was 63 years, and 66.2% of patients were male.

Baseline clinicopathological characteristics according to treatment response are presented in Table 1. No significant differences were observed between good and poor responders for age (p=0.400), gender (p=0.796), clinical T stage (p=0.084), clinical nodal status (p=0.123), clinical stage (p=0.268), histological subtype (p=0.379), signet-ring cell component (p=0.116), or mismatch repair status (p=0.146). However, the HALP score was significantly higher in good responders compared to poor responders (46.3±25.1 vs. 30.8±20.0; p=0.006).

ROC analysis demonstrated that the HALP score had a moderate ability to discriminate between good and poor responders, with an AUC of 0.700 (95% CI: 0.570-0.830;

TABLE 1: Baseline clinicopathological characteristics according to treatment response.				
Variables	**All (n=65)**	**Good responders (n=34)**	**Poor responders (n=31)**	**p-value**
Age, mean ± SD (median)	61.10±9.95 (63)	60.08±10.24 (61.5)	62.22±9.67 (65)	0.400
Gender				
Female	22 (33.8)	12 (35.3)	10 (32.2)	0.796
Male	43 (66.2)	22 (64.7)	21 (67.8)	
cT Stage				
cT2	10 (15.4)	8 (23.5)	2 (6.5)	0.084
cT3	38 (58.5)	16 (47.1)	22 (71.0)	
cT4	17 (26.2)	10 (29.4)	7 (22.6)	
cN Stage				
cN0	12 (18.5)	5 (14.7)	7 (22.6)	0.123
cN1	31 (47.7)	21 (61.8)	10 (32.3)	
cN2	16 (24.6)	6 (17.6)	10 (32.3)	
cN3	6 (9.2)	2 (5.9)	4 (12.9)	
c-Stage				
Stage 2	19 (29.2)	12 (35.3)	7 (22.6)	0.268
Stage 3	33 (50.8)	14 (41.2)	19 (61.3)	
Stage IVa	13 (20.0)	8 (23.5)	5 (16.1)	
Tumor location				
Gastric	57 (87.7)	28 (82.4)	29 (93.5)	0.455
GEJ	8 (12.3)	6 (17.6)	2 (6.5)	
Histological subtype				
Adenocarcinoma	49 (75.4)	28 (82.4)	21 (67.7)	0.379*
Signet ring cell carcinoma	9 (13.8)	4 (11.8)	5 (16.1)	
Others	7 (10.8)	2 (5.9)	5 (16.1)	
Signet-ring cell component				
Present	25 (38.5)	10 (29.4)	15 (48.4)	0.116
Absent	40 (61.5)	24 (70.6)	16 (51.6)	
Mismatch repair status				
MSS	58 (89.2)	28 (82.4)	30 (96.8)	0.146*
Unknown	7 (10.8)	6 (17.6)	1 (3.2)	
HALP score, mean ± SD (median)	38.9±23.9 (33.1)	46.3±25.1 (40.6)	30.8±20.0 (25.5)	0.006

Data are presented as mean ± standard deviation (median) or n (%). Continuous variables (age and HALP score) were compared using the Mann-Whitney U test. Categorical variables were compared using the χ^2 test or Fisher's exact test, as appropriate.
* Fisher's exact test was used where appropriate. GEJ: Gastroesophageal junction; SD: Standard deviation; MSS: Microsatellite stable; HALP: Hemoglobin, albumin, lymphocyte, and platelet.

p=0.006) (Figure 1). The optimal cut-off value of 38.6 yielded a sensitivity of 64.7%, specificity of 77.4%, positive predictive value of 75.9%, negative predictive value of 66.7%, and an overall diagnostic accuracy of 70.8%.

Patients were subsequently stratified according to the HALP cut-off value (Table 2). A significantly higher proportion of good responders was observed in the high HALP group than in the low HALP group (75.9% vs. 33.3%; p=0.001). In addition, patients with low HALP scores had significantly more advanced pathological tumor stage (ypT3-4: 83.3% vs. 48.3%; p=0.003) and nodal stage (p=0.003). A trend toward increased lymphovascular invasion was observed in the low HALP group, although this did not reach statistical significance (p=0.054). No significant differences were found in terms of type of surgery, extent of lymph node dissection, resection margin status, or perineural invasion.

In univariable logistic regression analysis, the HALP score was the only variable significantly associated with treatment

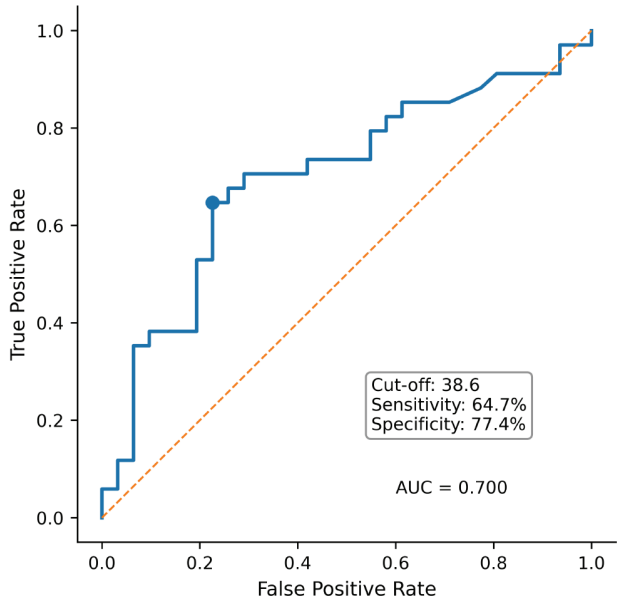

FIGURE 1. ROC curve of the HALP score for predicting treatment response based on TRG. The AUC was 0.700 (95% CI: 0.570-0.830; p=0.006). The optimal cut-off value (38.6) yielded a sensitivity of 64.7%, a specificity of 77.4%, a positive predictive value of 75.9%, a negative predictive value of 66.7%, and an overall diagnostic accuracy of 70.8%.

TRG: Tumor regression grade; AUC: Area under the curve; CI: Confidence interval; ROC: Receiver operating characteristic; HALP: Hemoglobin, albumin, lymphocyte, and platelet

response (Table 3). Patients with higher HALP scores had a significantly lower likelihood of poor response (OR: 0.16; 95% CI: 0.05-0.49; p=0.001). Other clinicopathological variables, including clinical T stage (p=0.105), clinical nodal status (p=0.414), histological subtype (p=0.345), and signet-ring cell component (p=0.119), were not significantly associated with treatment response. Internal validation using bootstrap resampling (1,000 samples) confirmed the robustness of the logistic regression model. The association between the HALP score and treatment response remained statistically significant after bootstrap validation (bootstrap coefficient: 1.838; bias: 0.066; BCa 95% CI: 0.802-3.173; p=0.001).

DISCUSSION

In the present study, we investigated the association between the HALP score, calculated at diagnosis, and pathological response to neoadjuvant chemotherapy in patients with LAGC. Our findings demonstrated that patients who did not respond to neoadjuvant treatment had significantly lower HALP scores and that the HALP score showed moderate discriminatory ability between good and poor responders. In addition, using an optimal cut-off value of 38.6 derived from ROC analysis, the HALP score effectively stratified patients by treatment response. Notably, in logistic regression analysis,

TABLE 2: Association between HALP score and clinicopathological features.

	HALP score <38.6 (n=36)	HALP score ≥38.6 (n=29)	p-value
TRG			
Good response	12 (33.3)	22 (75.9)	0.001
Poor response	24 (66.7)	7 (24.1)	
Type of surgery			
Subtotal gastrectomy	9 (25)	3 (10.3)	0.156*
Total gastrectomy	27 (75)	25 (86.2)	
Esophagectomy	0	1 (3.5)	
Extent of lymph node dissection			
D1	2 (5.6)	2 (6.9)	1.000
D2	34 (94.4)	27 (93.1)	
Resection margin status			
R0 (negative margin)	31 (86.1)	27 (93.1)	0.447*
R1 (microscopic residual disease)	5 (13.9)	2 (6.9)	
ypT stage			
T0-2	6 (16.7)	15 (51.7)	0.003
T3-4	30 (83.3)	14 (48.3)	
ypN stage			
N0	7 (19.4)	13 (44.8)	0.003*
N1	2 (5.6)	4 (13.8)	
N2	9 (25)	9 (31.0)	
N3	18 (50)	3 (10.3)	
Lymphovascular invasion			
Present	22 (61.1)	9 (31.0)	0.054
Absent	14 (38.9)	20 (69.0)	
Perineural invasion			
Present	18 (50)	9 (31.0)	0.283
Absent	18 (50)	20 (69.0)	

Data are presented as n (%). Comparisons between groups were performed using the χ^2 test or Fisher's exact test, as appropriate. The HALP cut-off value (38.6) was determined using receiver operating characteristic (ROC) curve analysis and the Youden index. TRG was assessed according to the Mandard classification, and patients were categorized as good responders (TRG 1-3) or poor responders (TRG 4-5).
ypT and ypN stages represent postoperative pathological tumor and nodal stages following neoadjuvant chemotherapy.
* Fisher's exact test was used where appropriate. TRG: Tumor regression grade; HALP: Hemoglobin, albumin, lymphocyte, and platelet.

the HALP score emerged as the only variable significantly associated with treatment response, highlighting its potential role as an independent predictive biomarker. These findings suggest that patients with low HALP scores may represent a subgroup at increased risk of poor pathological response and may therefore warrant closer clinical assessment. Prospective studies are needed to determine whether the HALP score could be used to guide individualized treatment strategies.

TABLE 3: Univariable logistic regression analysis for predictors of treatment response.

Variable	OR	95% CI	p-value
HALP (<38.6 vs. ≥38.6)	0.159	0.052-0.492	0.001
HALP (continuous)	0.969	0.946-0.993	0.013
cT stage	1.427	0.921-2.211	0.105
cN stage	1.117	0.862-1.449	0.414
Signet-ring component	2.248	0.832-6.076	0.119
Histological subtype	1.401	0.701-2.800	0.345

OR: Odds ratio; CI: Confidence interval; HALP: Hemoglobin, albumin, lymphocyte, and platelet.

Most of the existing literature on the HALP score has focused on postoperative survival outcomes rather than on treatment response. Indeed, previous studies and meta-analyses have consistently demonstrated that a low HALP score is associated with worse overall survival across multiple cancer types, including GC.[8,10] However, data evaluating the relationship between HALP and pathological response to neoadjuvant therapy remain limited, particularly in patients with LAGC.[11,12]

One of the distinguishing features of our study is the use of TRG as the primary endpoint. TRG represents an objective and standardized measure of pathological response following neoadjuvant therapy and has been shown to correlate strongly with both disease-free and overall survival.[13] By directly evaluating the association between HALP and TRG, our study provides novel insight into the predictive role of HALP beyond its established prognostic significance. Furthermore, we demonstrated that a low HALP score was associated not only with poor treatment response but also with more advanced postoperative pathological features, including higher ypT and ypN stages, thereby supporting its biological relevance in tumor aggressiveness and treatment resistance.

Systemic inflammation and nutritional status are increasingly recognized as key determinants of tumor biology, treatment response, and survival in GC. Various inflammatory and nutritional indices, including the Glasgow prognostic score, neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, prognostic nutritional index, and controlling nutritional status score, have been extensively investigated as prognostic markers.[14-16] These indices provide indirect insight into host-tumor interactions by reflecting the balance between systemic inflammation and nutritional reserve.

The HALP score, integrating hemoglobin, albumin, lymphocyte count, and platelet count into a single composite index, captures multiple aspects of host immunonutritional status.[8-10] Each of these components has well-established biological relevance in GC. Anemia and hypoalbuminemia reflect poor nutritional and systemic status and have been associated with worse clinical outcomes.[17-19] Lymphocytes play a central role in antitumor immunity and have been linked to both pathological response and survival in patients receiving neoadjuvant therapy.[20,21] In contrast, platelets contribute to tumor progression and angiogenesis through the release of growth factors (GFs) such as transforming GF-β and platelet-derived GF, and thrombocytosis has been reported as an adverse prognostic factor.[22-24] Therefore, a low HALP score may reflect an unfavorable host environment characterized by impaired immune surveillance, systemic inflammation, and poor nutritional status, which, in turn, may reduce sensitivity to cytotoxic therapy.

Another important issue in the literature is the variability in HALP cut-off values across studies. Reported cut-off values in GC range widely from 35.3 to 56.8, with a median of approximately 46.05.[10,25-28] This variability likely reflects differences in patient populations, disease stages, and treatment settings. In our study, the optimal cut-off value of 38.6, determined by ROC analysis, falls within this range and appears to be clinically meaningful in distinguishing treatment response groups. This finding further supports the context-dependent nature of HALP and highlights the importance of cohort-specific validation.

Although studies specifically evaluating the predictive role of HALP in neoadjuvant settings are limited, available data are consistent with our findings. In a multicenter retrospective study by Köşeci et al.[11], a HALP cut-off of 28.9 was associated with significantly higher pathological response rates in patients receiving neoadjuvant FLOT chemotherapy, and a higher HALP score increased the likelihood of response by approximately 6.5-fold. In contrast, our study was conducted in a single-center cohort in which all patients received a standardized four-cycle neoadjuvant FLOT regimen and in which pathological response was assessed using the Mandard TRG system. Similarly, a recent single-center study reported that the HALP score was independently associated with neoadjuvant chemotherapy response in gastric and gastroesophageal junction adenocarcinoma.[12] In addition, we demonstrated that the HALP score was associated not only with pathological response but also with postoperative pathological stage (ypT and ypN). Our findings are consistent with these studies and further extend the evidence by demonstrating a clear association of HALP with TRG-defined response and with postoperative pathological characteristics.

Taken together, our results suggest that the HALP score, a simple and readily available biomarker, may serve as a practical tool for predicting response to neoadjuvant chemotherapy in patients with LAGC. However, given the variability in cut-off values and the influence of comorbid conditions on HALP

components, this index should not be used in isolation but rather be interpreted in conjunction with clinical staging and other pathological parameters. Prospective multicenter studies are needed to validate these findings and establish standardized cut-off values for broader clinical application.

Study Limitations

This study has several limitations. First, its retrospective single-center design may have introduced selection bias and may have limited the generalizability of the findings. Second, although bootstrap resampling supported the robustness of the model, the relatively small sample size remains a limitation. In addition, the HALP cut-off value was derived from the same study cohort and was not externally validated. Therefore, some degree of overfitting cannot be excluded, and the proposed cut-off should be interpreted with caution until confirmed in larger independent cohorts. Third, diagnostic staging laparoscopy was not routinely performed before neoadjuvant chemotherapy. As a result, occult peritoneal metastases could not be completely excluded and may have influenced treatment completion and pathological response in a small number of patients. In addition, a small proportion of patients had an unknown MMR status, which may have affected the interpretation of treatment response. Finally, important factors that may influence the HALP score, such as body mass index, baseline weight loss or cachexia, comorbidities, and other conditions affecting nutritional or inflammatory status, were not systematically evaluated. Despite these limitations, all patients received the same standardized four-cycle FLOT regimen, and pathological response was assessed using the Mandard TRG system, resulting in a relatively homogeneous study population.

CONCLUSION

In conclusion, our study demonstrates that the HALP score, a simple and readily accessible immunonutritional biomarker, is significantly associated with the pathological response to neoadjuvant chemotherapy in patients with LAGC. A low HALP score was associated with poor treatment response and more advanced postoperative pathological features, including higher ypT and ypN stages. Notably, the HALP score emerged as the only significant predictor of treatment response in logistic regression analysis.

Unlike most previous studies that have primarily focused on survival outcomes, our findings highlight the potential predictive value of the HALP score for TRG, an objective and clinically meaningful endpoint of neoadjuvant treatment efficacy. These results suggest that the HALP score may serve as a practical tool for pre-treatment risk stratification and help identify patients less likely to benefit from standard neoadjuvant chemotherapy. Prospective multicenter studies are warranted to further validate these findings.

Ethics

Ethics Committee Approval: The study was approved by the University of Health Sciences Türkiye, İzmir City Hospital Non-Interventional Clinical Research Ethics Committee (approval number: 2025/297, date: 18.06.2025) and was conducted in accordance with the Declaration of Helsinki.

Informed Consent: Due to the retrospective nature of the study, the requirement for individual informed consent was waived.

Footnotes

Author Contributions

Surgical and Medical Practices: Ö.K., A.A., Concept: Ö.K., H.T., Ö.Ö., Design: Ö.K., D.G., H.T., Ö.Ö., Data Collection or Processing: Ö.K., G.G., Analysis or Interpretation: Ö.K., D.G., Literature Search: Ö.K., Writing: Ö.K., G.G.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

AI Disclosure Statement: During the preparation of this work, the authors utilized OpenAI's ChatGPT for language editing and structuring of the manuscript. All outputs were carefully reviewed, revised, and validated by the authors. The authors take full responsibility for the content of this manuscript.

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