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The prognostic value of HALP, SII, and SIRI scores in patients with acute calculous cholecystitis

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Abstract

Acute cholecystitis (AC) is a common surgical emergency, usually developing secondary to gallstones and characterized by gallbladder inflammation. Although classical biomarkers such as leukocyte count and C-reactive protein (CRP) are widely used for diagnostic purposes, composite inflammation-based indices such as Hemoglobin, albümin, lenfosit ve trombosit (HALP), Systemic immune-inflammation index (SII), and Systemic Inflammatory Response Index (SIRI) have recently emerged as important prognostic markers. This study aims to evaluate the association of HALP, SII, and SIRI scores with clinical outcomes [hospital length of stay, Internal care unit (ICU) requirement, and gallstone presence] in adults hospitalized with acute cholecystitis. A total of 88 patients hospitalized with acute cholecystitis between January 2020 and December 2024 were included. Demographic data, admission laboratory parameters, and HALP, SII, and SIRI scores were retrospectively analyzed. Correlation tests and Receiver Operating Characteristic (ROC) analysis were performed to assess prognostic performance. No statistically significant association was observed between HALP, SII, and SIRI scores and either length of hospital stay or intensive care unit requirement ($p>0.05$). In contrast, WBC levels showed a positive correlation with both parameters and were significantly higher in patients requiring intensive care ($p=0.035$). In ROC analysis, the Area Under the Curve (AUC) value for Leukocyte (WBC) was determined as 0.859. The significant increase in CRP and glucose levels in patients with acute cholecystitis acalculus suggests that this variant is associated with a more pronounced inflammatory process. In this study, traditional biomarkers especially WBC were more predictive of prognosis in acute cholecystitis than composite inflammation scores. Further time-series, prospective, and multicenter studies are warranted to validate the clinical utility of indices such as HALP, SII, and SIRI.

Keywords: Acute cholecystitis, hemoglobin, albümin, lenfosit ve trombosit score, systemic immune-inflammation index, prognostic markers, mortality

Introduction

AC is the most common complication of gallstone-related inflammation and represents a frequent clinical presentation in emergency departments. If not promptly diagnosed and managed, it may lead to significant morbidity. Early diagnosis and appropriate therapeutic planning are particularly crucial in elderly and comorbid individuals, as they directly influence clinical outcomes. In this context, in recent years, not only traditional biochemical and hematological parameters but also several systemic inflammation-based indices have gained increasing attention for predicting disease severity [1,2].

In addition to parameters such as value for Leukocyte (WBC) count, C-reactive protein (CRP), and glucose, composite inflammatory scores including Hemoglobin, albümin, lenfosit ve trombosit (HALP), Systemic Inflammatory Response Index (SIRI), and Systemic immune-inflammation index (SII) have emerged as novel markers in prognostic assessment [3,4]. The association of these scores particularly with length of hospital stay, intensive care unit requirement, and mortality holds potential to facilitate early decision-making processes in clinical management [5,6].

In the literature, the HALP score has been emphasized as an indicator that simultaneously reflects nutritional status and immune response, whereas the SII and SIRI scores are derived

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from neutrophil, lymphocyte, and monocyte counts and provide information regarding systemic inflammatory burden [7]. Moreover, several studies have reported that these parameters are significantly associated with prognostic outcomes such as the need for early surgery, development of complications, and length of hospital stay [8].

This study aims to demonstrate the relationship between blood parameters and HALP, SIRI, and SII scores with clinical indicators such as length of hospital stay, intensive care requirement, and the presence of gallstones in patients hospitalized with a diagnosis of acute cholecystitis.

Material and Methods

Following the approval obtained from the Scientific Research Ethics Committee of the Malatya Turgut Ozal University (approval date 2025, approval number 2025/420), the study was initiated. The data of adult patients who presented to the Emergency Department of Malatya Training and Research Hospital between January 2020 and December 2024 and were hospitalized with a diagnosis of acute cholecystitis were retrospectively reviewed. In accordance with the diagnostic framework defined in the Tokyo Guidelines (TG18), all patients included in the study fulfilled the diagnostic criteria for acute cholecystitis. Specifically, each patient met at least one local sign of inflammation (Murphy's sign or right upper quadrant pain/tenderness), at least one systemic inflammatory criterion (fever, leukocytosis, or elevated CRP levels), and demonstrated characteristic imaging findings (gallbladder wall thickening, pericholecystic fluid, distension, or sonographic Murphy's sign) on ultrasonography or computed tomography. Thus, all cases fully satisfied the TG18 requirements for a definitive diagnosis of acute cholecystitis.

The study aimed to determine the significance of blood parameters [complete blood count: WBC, hemoglobin (HGB), hematocrit (HCT), platelet (PLT), lymphocyte (LYM), monocyte, mean corpuscular volume (MCV), neutrophil (NEU); biochemistry: urea, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), albumin (Alb), glucose (GLC), sodium (Na), potassium (K), calcium (Ca)], CRP, and inflammation scoring systems [HALP, SIRI and SII] in predicting disease prognosis. Biochemical markers were measured in our hospital's biochemistry laboratory using the About device, with commercial kits for urea, creatinine, AST, ALT, Alb, GLC, Na, K, and Ca. Complete blood count parameters were also measured in the biochemistry laboratory using the SYSMEX XN-1000 h analyzer, with Cell pack DST (Diluent for Sysmex Technology), DCL (Detergent for Cleaning Line), WNR (White cell Nucleated Red cell), WDF (White Cell Differential), and SLS (Sodium Lauryl Sulfate) Lysercell kits.

Selection of Participants

According to ICD-10 coding in the Akgün information system of Malatya Training and Research Hospital, a total of 98 patient records with the diagnosis code K81.0 (Acute Cholecystitis) between January 2020 and December 2024 were identified. The discharge summaries of these patients were thoroughly reviewed in the Akgün information system. Ten patients who did not meet the inclusion criteria were excluded from the study. The study was conducted with the remaining 88 patients who fulfilled the eligibility criteria.

Exclusion Criteria

Patients younger than 18 years of age, those whose complete data could not be accessed in the hospital information system, and patients who were transferred to other hospitals from the emergency department or who declined hospitalization and left the hospital were excluded from the study.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA). The normality of distribution of variables was assessed using the Kolmogorov-Smirnov test. Descriptive statistical methods, including mean, median, standard deviation, percentage [25–75% Interquartile Range (IQR)] and frequency, were used to evaluate the study data. For comparisons of quantitative variables between two groups, Student's t-test was used for normally distributed parameters, while the Mann-Whitney U test was applied for non-normally distributed parameters. Categorical variables were compared using the Chi-square test (Pearson Chi-square or Fisher's exact test, where appropriate). Correlation analysis was performed for quantitative variables (blood parameters). ROC curve analysis was used to determine the sensitivity and specificity values of blood parameters in predicting mortality. A p-value <0.05 was considered statistically significant.

Result

A total of 88 patients were included in the study. The median age of the patients was 56.5 years (min–max: 39–67), and 75% (n=66) were female, while 25% (n=22) were male. The mortality rate was 1.1% (n=1), and 3.4% of patients (n=3) required admission to the intensive care unit. Gallstones were detected on ultrasonography in 65% of the patients. All of our patients fulfilled the definitive diagnostic criteria according to the Tokyo Guidelines. Patients were classified according to the Tokyo Guidelines for acute cholecystitis severity, and all cases were categorized as either Grade 1 or Grade 2. No statistically significant difference was detected in mortality between the Grade 1 and Grade 2 groups.

Among the hematological and biochemical parameters of the patients, hemoglobin (13.36±1.63) and potassium (4.16±0.58) levels demonstrated parametric distribution. Non-parametric data were presented as median with minimum–maximum values. WBC was 10.04 (4.8–18.6) $10^3/\mu L$, HCT 40.6% (13.4–51.7), MCV 83.9 (13.3–82.6) fL, NEU 7.6 (2.4–95.8) $10^3/\mu L$, monocytes 0.68 (0.1–10.4) $10^3/\mu L$, LYM 2.28 (0.2–44.6) $10^3/\mu L$, urea 26.1 (13–142) mg/dL, creatinine 0.74 (0.44–1.87) mg/dL, AST 27 (10–767) U/L, ALT 24 (8–539) U/L, GLC 109.5 (75–326) mg/dL, ALB 3.8 (2–4.7) g/dL, Na 138 (132–144) mmol/L, Ca 9.1 (7.6–14) mg/dL, chloride 107 (99–126) mmol/L, PLT 259 (130–469) $10^3/\mu L$, CRP 1.26 (0.02–

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33.8) mg/dL, HALP 0.447 (0.03–12.7), SIRI 2.16 (0.02–45.4), and SII 882 (12.7–11778). These results are presented in Table 1.

A statistically significant difference was observed between age and sex (p=0.008), indicating that acute cholecystitis occurred at an older age in male patients compared to female patients.

WBC levels were significantly higher in patients requiring intensive care compared to those who did not (p=0.035).

Glucose and CRP levels were significantly higher in patients with acute cholecystitis without gallstones on ultrasonography compared to those with gallstones (p=0.039 and p=0.026, respectively). In addition, the length of hospital stay was significantly longer in patients with calculous cholecystitis compared to those without gallstones (p=0.031) Table2. When patients requiring intensive care were compared with those who did not, there was no statistically significant difference in terms of the presence of gallstones (p=0.978).

No significant correlation was identified between SII, SIRI, and HALP scores and length of hospital stay (p=0.270, p=0.534, and p=0.629, respectively). A weak positive correlation was observed between WBC and length of hospital stay (r=0.237, p=0.026). In addition, a weak positive correlation was also detected between chloride levels and length of hospital stay (r=0.216, p=0.043) Table3.

Table 1. Mean (±SD) and Median (min–max) values of parametric and non-parametric blood parameters

Quantitative Data	n	mean±SD	Median(min-max)
Age(year)	88		56.5(23-90)
WBC (103/Ul)	88		10.04(4.8-18.6)
HGB (g/dL)	88	13.36±1.63	
HCT (%)	88		40.6(13.4-51.7)
MCV (fL)	88		83.9(13.3-82.6)
NEU (109L)	88		7.6(2.4-95.8)
MONO (109L)	88		0.68(0.1-10.4)
LYM (109L)	88		2.28(0.2-44.6)
Urea (mg/dL)	88		26.1(13-142)
Cr (mg/dL)	88		0.74(0.44-1.87)
AST (U/L)	88		27(10-767)
ALT (U/L)	88		24(8-539)
GLC (mg/dL)	88		109.5(75_326)
Alb (g/dL)	88		3.8(2-4.7)
Na(mmol/L)	88		138(132-144)
Ca (mg/dL)	88		9.1(7.6-14)
Cl (mmol/L)	88		107(99-126)
PLT(103/uL)	88		259(130-469)
CRP (mg/dL)	88		1.26(0.02-33.8)
K (mmol/L)	88	4.16±0.58	
HALP	88		0.447(.03-12.7)
SIRI	88		2.16(.02-45.4)
SII	88		882(12.7-11778)

WBC: leukocyte count, HGB: hemoglobin, HCT: hematocrit, MCV: mean corpuscular volume, NEU: neutrophil, MONO: monocyte, LYM: lymphocyte, Cr: creatinine, AST: aspartate aminotransferase, ALT: alanine aminotransferase, GLC: glucose, ALB: albumin, Na: sodium, K: potassium, Ca: calcium, Cl: chloride, PLT: platelet count, CRP: C-reactive protein, HALP: hemoglobin–albumin–lymphocyte–platelet score, SIRI: systemic inflammatory response index, SII: systemic immune-inflammation index

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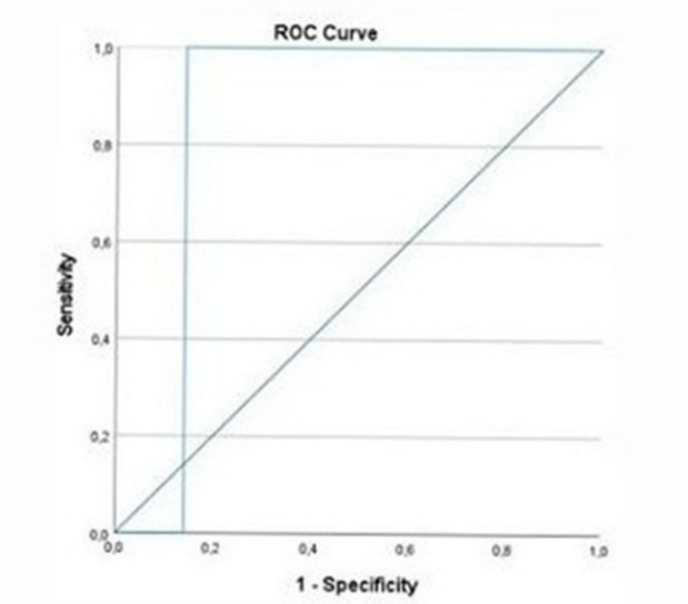

Figure 1. In the ROC analysis performed according to ICU admission status, WBC demonstrated an AUC of 0.859 (p=0.035). When a cut-off value of 14.8 was applied at the 95% confidence interval, a sensitivity of 66.7% and a specificity of 85.9% were obtained

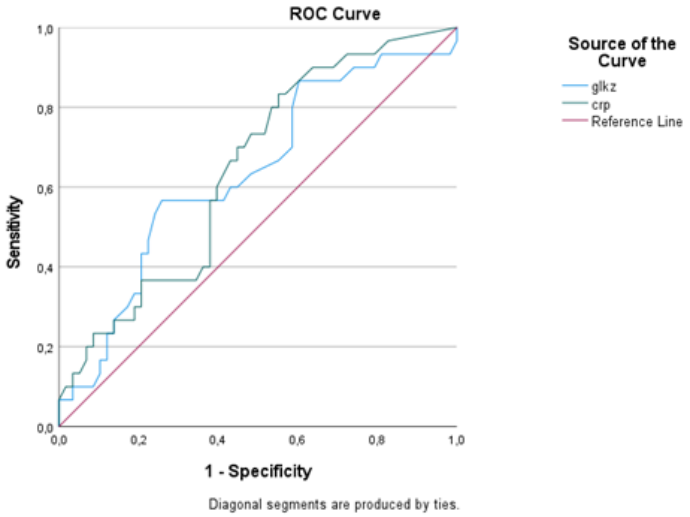

Figure 2. In the ROC analysis performed according to the presence or absence of gallstones, glucose demonstrated an AUC of 0.635 (p=0.063). When a cut-off value of 112 was applied at the 95% confidence interval, a sensitivity of 56.7% and a specificity of 58.6% were obtained. Similarly, in the ROC analysis based on gallstone status, CRP demonstrated an AUC of 0.645 (p=0.060). When a cut-off value of 0.75 was applied at the 95% confidence interval, a sensitivity of 48.3% and a specificity of 51.7% were obtained

Table 2. Association of Blood Parameters and Length of Hospital Stay Based on Ultrasonographic Detection of stones

Parameters	Ultrasonography	n	P value
GLC(mg/dL)	stone(–):	30	.039**
	stone(+)	58	
CRP	stone(–):	30	.026**
	stone(+)	58	
HA (day)	stone(–):	30	.031**
	stone(+)	58	

GLC: Glucose, CRP:C-Reaktif Protein, HA: hospital admission, stone(+): gallstones detected on ultrasonography, stone(–): no gallstones detected on ultrasonography

Table 3. Correlations Between Length of Hospital Stay and WBC, Chloride, SIRI, SII, and HALP

Parameters	Length of Hospital Stay (day)	n	r	p
WBC (103/Ul)		88	0.237*	0.026
Cl (mmol/L)		88	0.216*	0.043
HALP	Length of Hospital Stay (day)	88	0.052	0.629
SIRI		88	-0.067	0.534
SII		88	-0.119	0.270

WBC: leukocytes, HALP: HGB-ALB-LYM-PLT, SIRI: Systemic inflammatory response index, SII: Systemic immune-inflammation index

Discussion

AC is a frequently encountered surgical emergency that may increase morbidity and mortality, particularly in elderly patients and those with comorbidities [9–11]. In addition to biochemical and hematological parameters used in diagnostic and therapeutic decision-making, composite scores reflecting systemic inflammation (HALP, SII, SIRI) have recently been proposed as clinical decision-support tools [12–14]. This study

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aimed to contribute to the literature by evaluating the association between these scores and prognosis in patients hospitalized with a diagnosis of AC.

In our study, HALP, SII, and SIRI scores did not show a significant correlation with the length of hospital stay. Although this appears to contrast with some studies reporting prognostic value of these scores in patients undergoing abdominal surgery, it should be considered that the components of the HALP score (particularly alb and lym) reflect nutritional and immune status rather than acute inflammatory response. Therefore, it may be suggested that these scores may demonstrate a delayed response in acute inflammatory conditions such as AC [15,16].

In one study, it was reported that SII and SIRI scores yielded clinically meaningful results only in critically ill patients, whereas their clinical utility was limited in low- to moderate-risk cases. Similarly, in our study, given the low mortality rate (1.1%) and the small number of patients requiring intensive care, the predictive power of these scores was found to be weak [17].

The lack of significant results for these scores may be attributed to the fact that most patients in our cohort had mild-to-moderate disease severity, mortality was low, and scores such as HALP, SII, and SIRI tend to become more pronounced in the presence of severe inflammation and systemic response.

The positive correlation between WBC levels and both length of hospital stay and intensive care requirement is consistent with previous studies demonstrating the association of this parameter with AC severity. In our ROC analysis, the AUC value for WBC was 0.859, indicating a high predictive value with a specificity of 85.9%. Similarly, several studies have reported WBC as a marker associated with the severity of acute cholecystitis [6,12,18].

WBC is an inflammatory marker, and its elevation is an expected finding in relation to disease severity. Moreover, in acute cholecystitis, our results strongly support its prognostic value with robust statistical data, demonstrating this association clearly and consistently. The consistency with the existing literature strengthens the reliability of this finding, while the emphasis on AUC and specificity values clearly highlights its potential for clinical application.

The observation that CRP and glucose levels were higher in patients without gallstones on ultrasonography suggests that acalculous cholecystitis may be associated with a greater systemic inflammatory burden. This has been explained in the literature by the more pronounced systemic inflammation seen in acalculous cases, which are frequently observed among critically ill ICU patients. Therefore cholestasis, gallbladder ischemia, and systemic inflammation caused by pneumonia or any other sepsis could be responsible for the development of AAC in ICU patients [20]. The Tokyo Guidelines are widely used in the classification and management of AC severity [5,10]. Although not included within these guidelines, novel inflammatory scores such as HALP, SIRI, and SII have been proposed as potential supportive tools in clinical decision-making. Guideline developers emphasize the importance of evidence-based indicators and structured diagnostic flowcharts. Therefore, the use of scores such as HALP may be meaningful not as stand-alone markers, but in conjunction with guideline-based clinical pathways [5].

Previous studies have demonstrated the impact of surgical timing on patient prognosis and have reported that risk scores may provide guidance in this process. At this point, it may be suggested that these scores could be particularly useful in cases where clinical suspicion is high, yet early surgical intervention is approached with hesitation [3,4].

Another study demonstrated that classical hematological and inflammatory parameters such as leukocyte count, neutrophils, platelets, and CRP showed significant alterations in the diagnostic process of acute cholecystitis [21]. These findings are valuable in terms of illustrating how the systemic inflammatory response is reflected in laboratory data in AC. Furthermore, since these parameters constitute the components used in the calculation of inflammatory indices and the HALP score, they indirectly emphasize the potential diagnostic and prognostic relevance of these composite markers.

One study investigating factors influencing surgical timing in elderly patients reported that demographic variables such as age and sex may affect AC severity [22]. In our study as well, male patients presented with AC at a more advanced age. Differences in age and sex may be explained by hormonal influences, health-seeking behaviors, comorbidity burden, and variations in physiological inflammatory responses.

They have also emphasized the crucial role of percutaneous cholecystostomy in the management of high-risk patients. It may be suggested that such scores could serve as decision-support tools in these situations. In addition, alternative approaches such as EUS-guided drainage have been described as therapeutic options [23,24], and the use of scoring systems may become even more critical in these advanced interventions.

This examination has several limitations. First, due to its retrospective nature, analyses were only available from currently registered patient data. This limited our ability to evaluate dynamic parameters such as the timing of laboratory measurements, clinical decision-making processes, and treatment response. In addition, longitudinal follow-up data were not available, and therefore it was not possible to observe temporal trends in these scores within the clinical course (for example, the trajectory of HALP, SII, and SIRI values over the first 24–72 hours).

Another important limitation is the very low mortality rate in our study population (1.1%). This limited our ability to adequately assess the association of these scores with major clinical outcomes such as death.

Furthermore, composite scores such as HALP, SII, and SIRI were evaluated only based on laboratory values obtained at admission. However, time-dependent parameters—such as how these scores evolve during the clinical course, whether they parallel treatment response, or how they diverge in patients with

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clinical deterioration—are critical for understanding their true clinical utility. Therefore, the lack of serial measurements should be recognized as a significant limitation that may have limited the interpretability of these indices in prognostic stratification.

Conclusion

This examination is among the limited number of investigations evaluating the relationship between systemic inflammation-based scoring systems (HALP, SII, and SIRI) and clinical prognosis in hospitalized patients with acute cholecystitis. According to our findings, There is no significant correlation between these scores and parameters such as length of hospital stay and intensive care requirement may be related to the predominance of mild-to-moderate cases and the low rates of mortality and complications in our study population. On the other hand, classical inflammatory parameters such as WBC demonstrated strong predictive value and were identified as reliable biomarkers in the assessment of AC severity.

Markers such as CRP and glucose were found to be higher particularly in acalculous cholecystitis cases, suggesting a greater systemic inflammatory burden in this subgroup. For these scores to assume a complementary role in diagnostic and therapeutic processes, it is important to perform dynamic analyses supported by serial measurements rather than relying solely on admission values.

In conclusion, the use of scores such as HALP, SII, and SIRI in patients with acute cholecystitis should be interpreted in the context of patient profile, disease severity, and time-dependent variability. Larger, prospective, multicenter studies incorporating serial measurements are needed to enable more effective and reliable utilization of these scores in clinical practice.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study received ethical approval from the Scientific Research Ethics Committee of the Malatya Turgut Ozal University (approval date 2025, approval number 2025/420).

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