

The role of the HALP score and inflammatory biomarkers in differentiating complicated and uncomplicated acute appendicitis: a retrospective cohort study

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ABSTRACT

BACKGROUND: This study aimed to investigate the role of the HALP (hemoglobin, albumin, lymphocyte, platelet) score and inflammatory biomarkers C-reactive protein (CRP), neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR) in distinguishing between complicated and uncomplicated acute appendicitis.

METHODS: This retrospective study was conducted between May and August 2024 at Ankara Etlik State Hospital and included patients diagnosed with acute appendicitis who were treated surgically. HALP score, CRP, NLR, and PLR were calculated using preoperative laboratory results. Patients were categorized into complicated and uncomplicated appendicitis groups based on intraoperative and histopathological findings. Statistical analyses included the independent samples t-test, Mann-Whitney U test, and chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS: A total of 208 patients were analyzed. HALP scores were significantly lower in the complicated appendicitis group (4.6 vs. 5.8, $p=0.002$), while CRP levels were significantly higher (84.9 vs. 38.7 mg/L, $p<0.001$). NLR (7.0 vs. 6.9, $p=0.091$) and PLR (165 vs. 170, $p=0.767$) did not differ significantly between the groups.

CONCLUSION: CRP and HALP score are useful parameters for predicting complicated appendicitis. The HALP score, reflecting both systemic inflammation and nutritional status, may serve as a novel and cost-effective tool in clinical assessment.

Keywords: Acute appendicitis; HALP score; inflammatory markers.

INTRODUCTION

Acute appendicitis remains one of the most frequent causes of acute abdomen worldwide. Although its diagnosis is often straightforward, distinguishing between uncomplicated and complicated appendicitis is critical, as it influences treatment planning and prognosis. Complicated appendicitis, which includes perforation, gangrene, or periappendiceal abscess, is associated with higher morbidity, longer hospital stays, and an increased risk of sepsis. In contrast, uncomplicated cases may sometimes be managed conservatively with antibiotic therapy in selected patients.^[1,2]

Current diagnostic tools include imaging techniques such as ultrasonography and computed tomography (CT), along with clinical and laboratory findings. Among laboratory markers, white blood cell (WBC) count and C-reactive protein (CRP) levels are routinely used. Composite inflammatory indices such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have also been explored as predictors of disease severity.^[3,4] However, their sensitivity and specificity vary considerably across studies and populations.^[5]

The hemoglobin, albumin, lymphocyte, and platelet (HALP) score is a novel index initially developed by Chen et al.^[6] to

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predict prognosis in gastric cancer. Since then, its prognostic value has been demonstrated in stroke, malignancy, and cardiovascular disease.^[7,9] HALP integrates four routine laboratory parameters reflecting systemic inflammation, immune competence, and nutritional status. Despite its growing use in various diseases, its utility in acute surgical inflammatory conditions such as appendicitis has not been well characterized.

This study aimed to investigate whether the HALP score, alongside CRP, NLR, and PLR, could differentiate complicated from uncomplicated acute appendicitis and thereby serve as a valuable preoperative prognostic tool.

MATERIALS AND METHODS

Study Design and Setting

This retrospective cohort study was conducted at Ankara Etlik City Hospital between May and August 2024. Ethical approval was obtained from the hospital's Clinical Research Ethics Committee Ankara Etlik State Hospital (Date: 25.12.2024, Decision no: AEŞH-BADEK-2024-1080).

Patient Selection

Inclusion Criteria:

- Adults (≥ 18 years) who underwent appendectomy for acute appendicitis.
- Availability of complete preoperative laboratory and pathology data.

Exclusion Criteria:

- Incomplete or missing laboratory records.
- Chronic inflammatory or hematologic diseases.
- Patients receiving immunosuppressive therapy or with a history of malignancy.

Definitions and Grouping

Patients were categorized into complicated appendicitis (perforation, abscess, or gangrene confirmed intraoperatively or histopathologically) and uncomplicated appendicitis groups.

The severity of complications was graded using the Clavien-Dindo classification system. Postoperative outcomes, including length of hospital stay (LOS) and the need for intensive care unit (ICU) admission, were also recorded.

Data Collection and Calculations

Preoperative laboratory values obtained within 24 hours before surgery were extracted.

- $\text{HALP score} = (\text{Hemoglobin (g/L)} \times \text{Albumin (g/L)} \times \text{Lymphocyte (} 10^9/\text{L)}) / \text{Platelet (} 10^9/\text{L)}$
- $\text{NLR} = \text{Neutrophil (} 10^9/\text{L)} / \text{Lymphocyte (} 10^9/\text{L)}$
- $\text{PLR} = \text{Platelet (} 10^9/\text{L)} / \text{Lymphocyte (} 10^9/\text{L)}$

Additionally, demographic data, including body mass index

(BMI), American Society of Anesthesiologists (ASA) physical status scores, and history of chronic illnesses (e.g., diabetes mellitus, hypertension, and chronic obstructive pulmonary disease [COPD]) were extracted from hospital records.

Surgical Approach and Management

All patients diagnosed with acute appendicitis underwent surgical treatment. The decision between laparoscopic and open appendectomy was made by the attending surgical team based on the clinical presentation and surgeon preference. For patients with complicated appendicitis (i.e., perforation, abscess, or gangrenous changes), intravenous broad-spectrum antibiotics (e.g., ceftriaxone and metronidazole) were administered upon diagnosis. Emergency surgery was performed after initial stabilization. Intraoperative findings such as abscesses or perforation were managed with drainage and peritoneal lavage when necessary. Postoperative antibiotic regimens were adjusted based on intraoperative findings and culture results. No patients required reoperation during their hospital stay.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corporation, Armonk, NY, USA). The independent samples t-test was used for comparisons of continuous variables, while the Mann-Whitney U test was used for continuous variables that did not follow a normal distribution. The chi-square test was applied for comparisons of categorical variables. A p value < 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

A total of 208 patients were included in the study: 71 in the complicated appendicitis group and 137 in the uncomplicated appendicitis group. The mean age was 37.7 years in the complicated group and 36.4 years in the uncomplicated group. However, no statistically significant difference was observed between the two groups with respect to age ($p=0.414$). Regarding gender distribution, the female-to-male ratios were similar in both groups (complicated: F:M=0.73; uncomplicated: F:M=0.81), and no significant difference was found ($p=0.457$). These findings indicate that demographic factors do not play a significant role in the development of complications (Table 1).

Further analysis revealed no significant difference between the groups in terms of BMI (complicated: 26.1 vs. uncomplicated: 25.8, $p=0.317$). Similarly, ASA scores did not differ significantly between groups (ASA \geq III: 21.1% in the complicated group vs. 19.7% in the uncomplicated group, $p=0.448$). The prevalence of chronic comorbidities was also comparable (complicated: 28.2% vs. uncomplicated: 26.3%, $p=0.509$), indicating that baseline health status did not significantly influence the development of complications.

Table 1. Comparison of demographic characteristics between complicated and uncomplicated appendicitis groups

Variable	Complicated appendicitis (n=71)	Uncomplicated appendicitis (n=137)	p-value
Age	37.7	36.4	0.414
Gender (F/M)	F:M=0.73	F:M=0.81	0.457
BMI (kg/m ²)	26.1	25.8	0.317
ASA ≥III (%)	21.1%	19.7%	0.448
Chronic comorbidities (%)	28.2%	26.3%	0.509

F: Female; M: Male.

Comparison of Laboratory Values

Laboratory data from the complicated and uncomplicated appendicitis groups were analyzed comprehensively. No statistically significant differences were observed between the groups in white blood cell count, neutrophil (NEU), lymphocyte (LYM), platelet (PLT), hemoglobin (HGB), or platelet-to-lymphocyte ratio values ($p>0.05$). These parameters did not demonstrate a distinguishing role in predicting the development of complications (Table 2).

However, significant differences were observed in certain laboratory parameters:

- C-reactive protein levels were significantly higher in the complicated appendicitis group (84.9 vs. 38.7; $p<0.001$). CRP is a well-known marker of inflammatory processes and, in this study, emerged as an important biomarker for identifying the presence of complications.
- HALP score was significantly lower in the complicated group (5.8 vs. 4.6; $p=0.002$). A lower HALP score may reflect

increased inflammation in patients with complicated appendicitis.

- Albumin levels tended to be higher in the uncomplicated group (45.0 vs. 43.6), although the difference did not reach statistical significance ($p=0.066$). This finding suggests that lower albumin levels in patients with complicated appendicitis may be associated with the inflammatory response.

Operative Details

Of the total 208 patients, 123 (59.1%) underwent laparoscopic appendectomy and 85 (40.9%) underwent open appendectomy. The proportion of open surgeries was significantly higher in complicated cases (61.9%) compared to uncomplicated cases (29.2%) ($p<0.001$). The mean operative time was 58.4 ± 12.6 minutes for complicated appendicitis and 41.2 ± 10.7 minutes for uncomplicated cases ($p<0.001$). Additional intraoperative interventions, such as localized abscess drainage, were required in 18.3% of patients in the complicated group (Table 3).

Table 2. Laboratory data comparison between complicated and uncomplicated appendicitis groups

Parameter	Complicated appendicitis (n=71)	Uncomplicated appendicitis (n=137)	p-value
WBC	14.5	13.3	0.833
NEU	11.4	10.0	0.320
LYM	2.20	1.98	0.178
PLT	272	271	0.960
HGB	14.5	13.8	0.949
ALB	43.6	45.0	0.066
CRP	84.9	38.7	<0.001
NLR	7.0	6.9	0.091
PLR	165	170	0.767
HALP	4.6	5.8	0.002

WBC: White blood cell count; NEU: Neutrophil count; LYM: Lymphocyte count; PLT: Platelet count; HGB: Hemoglobin; ALB: Albumin; CRP: C-reactive protein; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio; HALP: Hemoglobin, albumin, lymphocyte, and platelet score.

Table 3. Operative characteristics

Variable	Complicated appendicitis (n=71)	Uncomplicated appendicitis (n=137)	p-value
Laparoscopic surgery (%)	27 (38.0%)	96 (70.1%)	<0.001
Open surgery (%)	44 (61.9%)	41 (29.9%)	<0.001
Mean operative time (min)	58.4±12.6	41.2±10.7	<0.001
Abscess drainage performed	13 (18.3%)	–	–

Table 4. Postoperative outcomes

Outcome	Complicated appendicitis (n=71)	Uncomplicated appendicitis (n=137)	p-value
Mean length of stay (days)	5.4±3.2	2.1±1.4	<0.001
ICU admission (%)	9 (12.7%)	0 (0%)	<0.001
Clavien–Dindo Grade I–II	40 (56.3%)	–	–
Clavien–Dindo Grade III	23 (32.4%)	–	–
Clavien–Dindo Grade IV	8 (11.3%)	–	–

Postoperative Complications and Outcomes

Among the 71 patients with complicated appendicitis, 27 (38.0%) had perforation, 17 (23.9%) had gangrenous appendicitis, and 10 (14.1%) developed periappendiceal abscesses. The remaining 17 patients (23.9%) exhibited mixed or non-specific intraoperative findings. According to the Clavien–Dindo classification, Grade I–II complications were observed in 40 patients (56.3%), Grade III in 23 patients (32.4%), and Grade IV in eight patients (11.3%).

The mean length of hospital stay was significantly longer in complicated cases (5.4±3.2 days) compared to uncomplicated cases (2.1±1.4 days) ($p<0.001$). ICU admission was required in nine patients (12.7%) in the complicated group, whereas no ICU admissions occurred in the uncomplicated group ($p<0.001$) (Table 4).

Among the complicated cases, intraoperative abscess drainage was performed in 13 patients (18.3%). No patient required reoperation. Postoperative recovery was uneventful in the majority of patients.

DISCUSSION

Acute appendicitis remains one of the most common causes of acute abdominal pain requiring emergency surgery. It is classically categorized into uncomplicated (non-perforated) and complicated (perforated, gangrenous, or associated with periappendiceal abscess) forms, with the latter associated

with higher morbidity, prolonged hospital stays, and an increased risk of postoperative complications.^[10,11] Early and accurate differentiation between these subtypes is essential to guide appropriate surgical and perioperative management. While imaging modalities such as ultrasonography and CT play a critical role in diagnosis, laboratory parameters and scoring systems are frequently used to aid risk stratification.^[12]

In our clinical setting, all patients with complicated appendicitis received prompt intravenous antibiotic therapy upon diagnosis, followed by urgent surgical intervention. Perioperative management included peritoneal lavage and abscess drainage when necessary. Broad-spectrum antibiotics were continued postoperatively and adjusted based on intraoperative culture results. This approach was successful in preventing the need for reoperation or prolonged ICU support in most patients. These findings underscore the importance of a standardized management protocol in improving outcomes for patients with complicated appendicitis.

This study demonstrates a statistically significant relationship between lower HALP scores and the presence of complicated acute appendicitis. Among the evaluated parameters, only CRP and HALP showed significant differences between complicated and uncomplicated cases. While CRP's acute-phase dynamics are well established in inflammatory conditions and are particularly useful for early risk stratification ($p<0.001$),^[13,14] the HALP score, a composite marker reflecting hemoglobin, albumin, lymphocyte, and platelet levels, pro-

vides a broader systemic perspective that incorporates nutritional and immune status.

Initially introduced by Chen et al.^[6] for prognostic assessment in gastric cancer, the HALP score has since been validated across various chronic and malignant conditions, including colorectal,^[15] pancreatic,^[16] and hepatocellular cancers.^[17] Beyond its oncologic applications, recent studies have also explored its role in acute inflammatory conditions such as pancreatitis^[18] and intestinal obstruction,^[19] where it has shown potential as a prognostic marker. Consistent with these findings, our study observed significantly lower HALP scores in patients with complicated appendicitis ($p=0.002$), supporting earlier evidence by Benli et al.,^[20] who reported a similar association between reduced HALP values and higher rates of postoperative morbidity in acute appendicitis.

Nevertheless, the clinical utility of HALP in acute surgical settings must be interpreted with nuance. Its components, particularly albumin and hemoglobin, respond slowly to acute inflammatory stimuli and are more reflective of a patient's baseline physiological reserve than of immediate disease activity.^[21] Given that the majority of appendicitis patients undergo surgery shortly after diagnosis and are discharged within 1-2 days, the delayed kinetics of HALP components limit its usefulness for real-time clinical decision-making. Although statistically significant, its contribution to immediate clinical management appears limited when compared to CRP or white blood cell count.

Moreover, while the expanding interest in HALP has led to its application in diverse clinical settings, there is concern that its inclusion in acute care research may sometimes reflect trend-driven investigation rather than a grounded clinical rationale. In this study, although HALP scores correlated with disease severity, they did not provide additional predictive value beyond CRP. Therefore, HALP may be better conceptualized as a supplementary risk stratification tool, particularly for patients with chronic illnesses, poor nutritional status, or equivocal clinical presentations, rather than as a first-line prognostic marker in acutely evolving surgical emergencies.

Similarly, although the neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio have gained popularity as accessible markers of systemic inflammation and prognosis, their diagnostic and prognostic performance in appendicitis remains variable. Several studies suggest that elevated NLR values (commonly >4.7 or >8.8) may correlate with complicated appendicitis or perforation,^[22,23] and PLR has also been investigated as a marker of disease severity.^[24,25] However, in our study, neither NLR nor PLR showed significant differences between the groups (NLR $p=0.091$; PLR $p=0.767$). These findings align with certain meta-analyses that question the consistency of these ratios, possibly due to differences in the timing of blood sampling, disease stage, or inter-individual variability.^[26]

In summary, while HALP demonstrates statistical relevance

in distinguishing complicated from uncomplicated appendicitis, its clinical applicability is limited by its non-acute kinetic profile. In most cases of acute appendicitis, particularly those managed promptly with surgery, HALP provides minimal additional prognostic value beyond CRP. It may have adjunctive value in selected clinical scenarios but should not be overemphasized in acute decision-making algorithms. Future studies may further clarify its role, especially in complex or comorbid patient populations.

CONCLUSION

In this study, HALP and CRP were significantly associated with complicated appendicitis. The HALP score, as a novel and accessible biomarker, may assist clinicians in early risk stratification and operative decision-making. Larger, prospective trials are warranted to validate its clinical utility.

Ethics Committee Approval: This study was approved by the Clinical Research Ethics Committee Ankara Etilik State Hospital (Date: 25.12.2024, Decision No: AEŞH-BADEK-2024-1080).

Informed Consent: Retrospective study.

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Conflict of Interest: None declared.

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ORIJİNAL ÇALIŞMA - ÖZ

Komplike ve komplike olmayan akut apandisitlerin ayırımında HALP skoru ve enflamatuvar biyobelirteçlerin rolü: Retrospektif kohort çalışması

AMAÇ: HALP (Hemoglobin, Albümin, Lenfosit, Trombosit) skoru ve enflamatuvar biyobelirteçler C-reaktif protein (CRP), nötrofil-lenfosit oranı (NLR) ve trombosit-lenfosit oranının (PLR) komplike ve komplike olmayan akut apandisit arasındaki ayrımı yapmadaki rolünü araştırmak.

GEREÇ VE YÖNTEM: Bu retrospektif çalışma Mayıs ve Ağustos 2024 tarihleri arasında Ankara Etlik Şehir Hastanesi'nde yürütülmüş olup akut apandisit tanısı konulan ve cerrahi olarak tedavi edilen hastaları kapsamıştır. HALP skoru, CRP, NLR ve PLR ameliyat öncesi laboratuvar sonuçları kullanılarak hesaplanmıştır. Hastalar intraoperatif ve histopatolojik verilere göre komplike ve komplike olmayan apandisit olarak gruplandırılmıştır. İstatistiksel analizler Bağımsız Örneklem t-testi, Mann-Whitney U ve ki-kare testlerini içermektedir. p-değeri <0.05 anlamlı kabul edilmiştir.

BULGULAR: Toplam 208 hasta analiz edilmiştir. HALP skorları komplike grupta önemli ölçüde daha düşüktü (4.6'ya karşı 5.8, p=0.002) ve CRP seviyeleri önemli ölçüde daha yüksekti (84.9'a karşı 38.7 mg/L, p<0.001). NLR (7.0'a karşı 6.9, p=0.091) ve PLR (165'e karşı 170, p=0.767) gruplar arasında önemli ölçüde farklılık göstermedi.

SONUÇ: CRP (C-reaktif protein) ve HALP (Hemoglobin, Albümin, Lenfosit, Trombosit) skoru komplike apandisiti tahmin etmede yararlı parametrelerdir. Hem sistemik inflamasyonu hem de beslenme durumunu yansıtan HALP (Hemoglobin, Albümin, Lenfosit, Trombosit) skoru, klinik değerlendirmede yeni ve maliyet etkin bir araç olarak hizmet edebilir.

Anahtar sözcükler: Akut apandisit; HALP skoru; enflamatuvar belirteç.

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