ORIGINAL ARTICLE

The role of infectious parameters in the early prediction of complicated colonic diverticulitis

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ABSTRACT

BACKGROUND: Acute colonic diverticulitis has recently become a significant cause of hospital admissions. Complicated colonic diverticulitis, a severe form of the disease, necessitates medical and surgical intervention. Prompt diagnosis in these patients is crucial. This study aims to assess the role of infectious parameters in the early diagnosis of complicated colonic diverticulitis.

METHODS: This retrospective study analyzed 82 adult patients diagnosed with acute diverticulitis. Recorded data included patient demographics, hospital stay duration, disease location, and surgical procedures. Infectious parameters such as white blood cell count (WBC), C-reactive protein (CRP), neutrophil/lymphocyte ratio (NLR), percentage of immature granulocytes (IG%), and systemic immune-inflammatory index (SII) were calculated and noted. Patients underwent abdominal computed tomography upon admission, and based on these results, they were categorized into uncomplicated or complicated diverticulitis groups. Statistical analysis was performed to identify differences between these groups.

RESULTS: CRP, NLR, and SII were significantly more predictive of complicated acute colonic diverticulitis. However, no statistical differences in WBC and IG% values were observed between the groups.

CONCLUSION: The study found that the percentage of immature granulocytes, previously deemed a reliable marker in many studies, did not significantly predict complicated colonic diverticulitis. Further comprehensive studies are necessary to explore inflammatory markers in colonic diverticulitis more thoroughly.

Keywords: Complicated colonic diverticulitis; early prediction; infectious markers.

INTRODUCTION

Diverticular disease occurs from mucosal protrusion due to muscle layer deficiencies.[1] Herniation in the colon wall arises from increased intraluminal pressure at weak points.[2] Common in adults over 40, its incidence rises with age.[3] Etiologically, colon wall resistance changes, motility disorders, and low fiber diets are significant.[4] This disease is prevalent in Western populations with insufficient fiber intake, often affecting the descending and sigmoid colon.[5]

Diverticular disease spans from uncomplicated to complex conditions such as acute diverticulitis, bleeding, pericolic abscess, and intra-abdominal abscess, with acute colonic diverticulitis occurring in 10-25% of patients.[6] Acute diverticulitis classification relies on patient history, clinical, laboratory, and radiological findings. The Hinchey classification is a widely

used staging system,[7] alongside other systems developed by Sher, Wasvary, Köhler, Hansen/Stock, Siewert, and Ambrosetti.[8] According to The World Society of Emergency Surgery guidelines, acute diverticulitis is easily classified as complicated or uncomplicated. Uncomplicated cases involve colonic wall thickening and denser pericolic fat, whereas complicated cases extend to pericolic or intraabdominal abscess, distant free gas, and diffuse fluid.[9]

The percentage of immature granulocytes (IG%) has recently become a notable inflammation marker, measurable from routine complete blood counts.[10,11] Studies suggest IG%'s effectiveness in severe infections, alongside white blood cell count (WBC), C-reactive protein (CRP), and neutrophil-lymphocyte ratio (NLR).[12,13] The systemic immune-inflammatory index (SII), calculated from platelet, neutrophil, and lymphocyte counts, has been recognized as a reliable marker of local immune response and systemic inflammation.[14,15]

Recently, hospital admissions for both complicated and uncomplicated diverticulitis have risen notably. While uncomplicated cases are often managed in outpatient clinics, complicated diverticulitis requires hospitalization for medical treatment and, in non-responsive cases, surgery. This increase in medical and surgical interventions has elevated hospital costs. Consequently, early diagnosis of complicated diverticulitis is viewed as an essential strategy to reduce these costs.[16]

This study aims to evaluate the effectiveness of SII and IG% alongside traditional infectious parameters like CRP, WBC, NLR in distinguishing patients with complicated and uncomplicated diverticulitis hospitalized for acute diverticulitis in our general surgery clinic.

MATERIALS AND METHODS

This retrospective study was conducted on 82 patients diagnosed with acute diverticulitis, who were hospitalized in the General Surgery Clinic of Ankara Training and Research Hospital from January 2017 to December 2021. The study received approval from the Local Ethics Committee of Ankara Training and Research Hospital (Approval number: 1226/2023). Upon admission, all patients underwent abdominal computed tomography (CT). Laboratory tests, including a complete blood count and biochemical parameters, were performed. Infection parameters such as white blood cell count (WBC), neutrophil/lymphocyte ratio (NLR), percentage of immature granulocytes (IG%), and C-reactive protein (CRP) values were examined in these tests. The systemic immune-inflammatory index (SII) was calculated by multiplying the platelet count by the NLR derived from the complete blood count.

Based on the results of the CT scans, laboratory data, and clinical findings, patients were categorized into two groups: uncomplicated and complicated. Patients showing only heterogeneity and inflammation in pericolic fatty tissue in tomo-graphic findings were classified as uncomplicated. In contrast, those with abscesses, perforations, and free diffuse fluid were classified as belonging to the complicated patient group. The demographic data of the patients, length of hospital stay, and surgical records were extracted from the hospital database for statistical comparison.

Statistical Analysis

The data were analyzed using IBM SPSS Statistics version 25.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics are presented as the number of units (n), percentage (%), mean ± standard deviation (SD), or median (Q1-Q3) values. The Pearson Chi-Square test and Fisher's Exact test were utilized for evaluating categorical variables. The conformity of numerical variables to the normal distribution was assessed using the normality test and Q-Q plots. For comparing two groups, the Independent Samples t-test was applied to variables with a normal distribution, and the Mann-Whitney U test was used for variables without a normal distribution. Patients were categorized as having uncomplicated or complicated diverticulitis based on clinical findings.

Receiver Operating Characteristic (ROC) analysis was conducted to assess the effectiveness of inflammation markers (WBC, CRP, NLR, SII, and IG%) in differentiating complicated diverticulitis. Threshold values were determined using the Youden index. Specificity, sensitivity, positive predictive value, and negative predictive value were calculated based on these threshold values. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 82 patients diagnosed with acute diverticulitis were evaluated, consisting of 47 females (57.3%) and 35 males (42.7%), with a median age of 54.5 years (IQR: 41.0-65.0, range 20-91 years) (Table 1).

Based on clinical and CT findings, the patients were divided into two groups: uncomplicated diverticulitis and complicated diverticulitis. Uncomplicated diverticulitis was identified in 65 out of 82 patients (79.3%), while complicated diverticulitis was present in 17 patients (20.7%) (Table 1).

There was no statistically significant difference in gender distribution between the uncomplicated and complicated diverticulitis groups (p=0.682). The median age in the complicated diverticulitis group was significantly higher than in the uncomplicated group (p=0.039). In terms of hospital stay length, patients with complicated diverticulitis had a significantly longer stay compared to those with uncomplicated diverticulitis (p=0.000) (Table 1).

In the uncomplicated group, disease location was identified in the descending and sigmoid colon in 60 of 65 patients (92.3%) and in the ascending and transverse colon in 5 patients (7.7%). In the complicated group, the disease location was in the descending and sigmoid colon in 15 of 17 patients (88.2%) and

Table 1. The comparison of demographic data, length of hospital stay, resection and location between two groups

	Uncomplicated Diverticulitis	Complicated Diverticulitis	p
Number of patients	65 (%79.3)	17 (%20.7)	
Median age(years)	53.0 (40.5-63.0)	64.0 (48.0-71.5)	0.039
Length of hospital stay(day)	4.0 (3.0-5.0)	8.0 (4.5-13.0)	0.000
Gender			
Female	38 (%58.5)	9 (%52.9)	
Male	27 (%41.5)	8 (%47.1)	0.682
Resection			
Resection -	65 (%100.0)	10 (%58.8)	
Resection +	0 (%0.0)	7 (%41.2)	<0.001
Location			
Ascending and transvers colon	5 (%7.7)	2 (%11.8)	
Descending and sigmoid colon	60 (%92.3)	15 (%88.2)	0.593

in the ascending and transverse colon in 2 patients (11.8%). No significant difference was observed between the groups in terms of disease location (p=0.593). (Table 1)

The rate of resection surgery was significantly higher in the complicated diverticulitis group compared to the uncomplicated group (p<0.001). (Table 1)

In assessing infectious parameters, CRP, NLR, and SII values were significantly higher in the complicated diverticulitis group, while no significant difference was found in WBC and IG% values between the two groups. The comparison of infectious parameters between uncomplicated and complicated diverticulitis groups is shown in Table 2.

ROC curve analysis was conducted to evaluate the effectiveness of WBC, CRP, NLR, SII, and IG% in detecting patients with complicated diverticulitis (Fig. 1).

CRP, NLR, and SII were identified as significant parameters for predicting complicated diverticulitis (Table 3).

DISCUSSION

Colonic diverticular disease, characterized by varying clinical presentations, increases in incidence with age. It has been
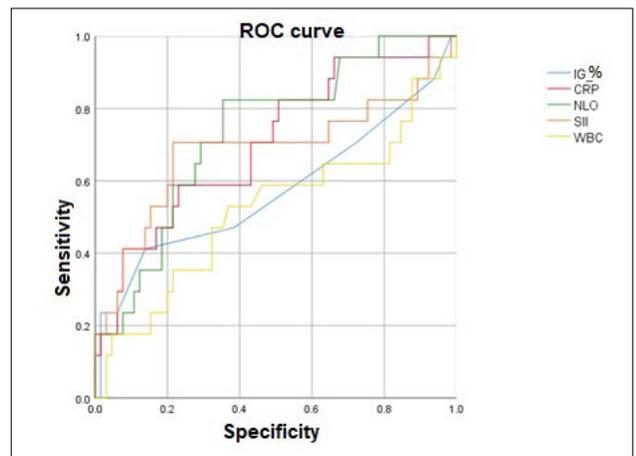
Figure 1. Receiver operating characteristic curve analysis of inflammation markers in discrimination between uncomplicated and complicated diverticilitis.

reported in over 60% of individuals above 60 years.[17] Studies indicate that patients with complicated colonic diverticulitis are typically older than those with uncomplicated cases. The likelihood of complications escalates with age, possibly due to concurrent comorbidities that accompany aging.[18-20] In line

Table 2. The comparison of inflammation markers between the groups

	Uncomplicated Diverticulitis	Complicated Diverticulitis	p
WBC (10⁹/L)	12.5 (10.7-14.8)	13.1 (9.5-16.2)	0.784
NLR	3.6 (2.3-4.5)	5.0 (3.9-7.5)	0.003
CRP (mg/L)	35.5 (16.7-81.7)	98.4 (35.4-156.8)	0.009
IG %	0.4 (0.3-0.5)	0.4 (0.3-0.8)	0.342
SII	668.3 (139.7-1,042.7)	1,362.1 (319.5-2,356.1)	0.020

WBC: White blood cell count; NLR: neutrophil/lymphocyte ratio; CRP: C-reactive protein; IG%: percentage of immature granulocytes; SII: Systemic immune inflammatory index.

Table 3. ROC analysis of inflammation markers in the prediction of complicated diverticulitis

	Cutoff	AUC	Sensitivity (%)	Specificity (%)	PPV (%)	NPV(%)	p value
NLR	3.82	0.735 (0.604-0.866)	82.4	64.6	37.8	93.3	0.003
CRP	93.97	0.706 (0.560-0.852)	58.8	76.9	40	87.7	0.009
SII	1199.48	0.684 (0.506-0.862)	70.6	78.5	46.1	91.1	0.020
IG %	0.6	0.573 (0.392-0.754)	41.2	86.2	43.8	84.8	0.354
WBC	13.07	0.522 (0.344-0.699)	52.9	63.1	27.2	83.7	0.784

WBC: White blood cell count; CRP: C-reactive protein; SII: Systemic immune inflammatory index; IG%: percentage of immature granulocytes; NLR: neutrophil/lymphocyte ratio; PPV: Positive predictive value; NPV: Negative predictive value; ROC: Receiver operating characteristic; AUROC: Area under ROC.

with previous research, the current study found the median age of patients with complicated colonic diverticulitis to be higher than those with uncomplicated cases. Although environmental and lifestyle factors significantly influence etiology, risk factors such as a Western lifestyle, fiber-poor diet, obesity, and smoking have heightened the prevalence of colonic diverticulitis.[21] Acute colonic diverticulitis predominantly occurs in the descending and sigmoid colon in Western societies, with lesser incidence in the ascending colon.[1] This study's findings mirror the literature, indicating a higher occurrence in the descending and sigmoid colon among our patient cohort.

In developed societies, where diverticular disease is more prevalent, most cases remain asymptomatic, but approximately 10-25% of individuals develop acute diverticulitis.[6] The clinical manifestations of acute diverticulitis vary based on the disease severity. Mild, uncomplicated cases can be managed in outpatient settings, while complicated cases necessitate hospitalization. Complicated diverticulitis may present with severe conditions such as colon perforation and pericolic or intra-abdominal abscesses, posing life-threatening risks without effective treatment. Moreover, these cases lead to extended hospital stays and increased medical costs. Thus, early diagnosis and treatment of acute complicated diverticulitis are crucial.

Various inflammatory markers like WBC, NLR, and CRP have been utilized by researchers to differentiate between complicated and uncomplicated acute diverticulitis.[22-24] The present study aimed to evaluate the effectiveness of IG% and SII alongside these traditional inflammatory markers in distinguishing between uncomplicated and complicated diverticulitis.

In a systematic review by Tan et al., evaluating white blood cell (WBC) count as a crucial indicator of inflammation, it was observed that significantly higher WBC levels were noted in complicated acute diverticulitis compared to uncomplicated cases in only one of the reviewed studies focusing on acute diverticulitis. However, other studies found no significant differences in WBC levels concerning severity and prognosis.[22] Similarly, in our study, although WBC values were elevated in acute diverticulitis patients, no statistically significant difference was observed between complicated and uncomplicated cases in terms of WBC values.

C-reactive protein (CRP), an acute-phase reactant, is frequently assessed in inflammatory conditions. Tan et al.'s systematic review found a strong correlation between high CRP levels and the severity of acute diverticulitis.[22] This aligns with our current findings, where CRP values were significantly higher in patients with complicated acute diverticulitis.

Neutrophil-lymphocyte ratio (NLR) is another inflammation indicator. NLR levels have been studied in various conditions, including acute appendicitis, acute cholecystitis, and coronary artery disease.[25,26] In previous research on diverticulitis, NLR was highlighted as a reliable marker.[23] Consistent with this, our study found a significant difference in NLR levels in patients with complicated acute diverticulitis.

The systemic immune-inflammatory index (SII) has been identified as a dependable marker in systemic inflammation scenarios, particularly in prognostic assessments of patients with malignancies.[14] Recently, it has also been examined in intra-abdominal inflammatory events.[27,28] In our study, SII values were significantly higher in patients with complicated acute diverticulitis compared to those with uncomplicated cases.

The percentage of immature granulocytes (IG%) may be more effective in severe infections, alongside WBC, CRP, and NLR. IG% has been shown to provide valuable insights into disease severity in conditions with severe inflammation, such as acute necrotizing pancreatitis, acute cholecystitis, and perforated appendicitis.[12,13,29,30] However, some studies indicate that IG% might not offer additional benefits compared to other inflammatory markers.[31,32] In our study, no statistically significant difference in IG% values was found between complicated and uncomplicated acute diverticulitis patients.

This study has limitations, including its retrospective design and single-center nature, which may affect the generalizability of the results. Additionally, the relatively small sample size is a constraint. Further research with larger cohorts and a more comprehensive investigation of inflammatory markers would enrich the existing literature on this topic.

CONCLUSION

Acute colonic diverticulitis represents a significant group of diseases leading to hospital admissions in general surgery clinics. Accurately determining the severity of the disease by distinguishing between complicated and uncomplicated cases upon hospital admission plays a vital role in reducing hospital stays and associated costs. Prompt diagnosis of complicated diverticulitis and timely determination of the appropriate treatment plan are crucial. This study's findings indicate that neutrophil-lymphocyte ratio (NLR), C-reactive protein (CRP), and systemic immune-inflammatory index (SII) are more effective markers for differentiating between complicated and uncomplicated diverticulitis. While white blood cell (WBC) counts were elevated in both groups, statistical significance may not have been achieved due to the older age of patients with complicated diverticulitis, which could lead to an inadequate WBC response. The effectiveness of the percentage of immature granulocytes (IG%), deemed a reliable marker in several severe inflammatory conditions, was not conclusive in this context. Future studies involving larger and more diverse patient groups are anticipated to yield more definitive results regarding these inflammatory markers.

Ethics Committee Approval: This study was approved by the Ankara Training and Research Hospital Ethics Committee (Date: 08.03.2023, Decision No: 1226-2023).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Komplike kolonik divertikülitlerde erken tahminde enfeksiyöz parametrelerin rolü

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AMAÇ: Akut kolonik divertikül son yıllarda hastaneye başvurularında ön planda bir hastalık grubudur. Komplike kolonik divertikülitler ise bu hastalık grubunun medikal ve cerrahi olarak tedavi gerektiren şiddetli bir halidir. Bu grup hastaların erken teşhis edilebilmesi son derece önemlidir. Çalışmamız komplike kolonik divertikül hastalarını ön görmede enfeksiyöz parametrelerin rolünün değerlendirilmesini amaçlamaktadır.

GEREÇ VE YÖNTEM: Retrospektif olarak yapılan bu çalışma akut divertikül tanısı almış 82 erişkin hasta üzerinde gerçekleştirildi. Hastaların demografik verileri, hastanede yatış süreleri, hastalığın lokasyonu ve cerrahi işlem olup olmadığı kaydedildi. Enfeksiyöz parametre olarak beyaz küre, C-reaktif protein, nötrofil/lenfosit oranı, immatür granülosit yüzdesi ve sistemik immün inflamatuvar indeks hesaplandı ve kaydedildi. Hastalara yatış esnasında abdominal tomografi çekildi ve sonuçlarına göre komplike olmayan ve komplike divertikül olarak 2 gruba ayrıldı. Gruplar arasındaki farklılıklar istatistiksel olarak analiz edildi.

BULGULAR: Komplike akut kolonik divertiküliti ön görmede C-reaktif protein, nötrofil/lenfosit oranı ve sistemik immün enflamatuvar indeks daha anlamlı olarak bulundu. İki hastalık grubu arasında beyaz küre ve immatür granülosit yüzdesi değerlerinde istatistiksel olarak fark bulunamadı.

SONUÇ: Yaptığımız çalışmada daha önce birçok çalışmada güvenilir bir belirteç olarak değerlendirilen immatür granülosit yüzdesi komplike kolonik divertikülitleri ön görmede anlamlı bulunamamıştır. Yapılacak daha geniş kapsamlı çalışmalarla komplike kolonik divertikülitlerde enfeksiyöz parametreler araştırılabilir.

Anahtar sözcükler: Komplike kolonik divertikülit; enfeksiyöz parametreler; erken tahmin.