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Red cell distribution width as a potential new biomarker to predict the clinical severity of acute diverticulitis

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Abstract

Objective To investigate the relationships between red cell distribution width (RDW), other inflammation-related markers and clinical features with the clinical and radiological severity of diverticulitis.

Methods This retrospective cohort study included 250 patients diagnosed with acute diverticulitis. Radiological diverticulitis severity was determined by the Hinchey classification. Clinical diverticulitis severity was determined based on the treatment applied (invasive versus conservative/medical treatment).

Results High platelet count ($p=0.001$) and high CRP ($p<0.001$) were independently associated with the Hinchey Class II-IV. Need for invasive treatment was independently associated with presence of Hinchey stage II-IV ($p<0.001$) and high (> 13.75) RDW ($p<0.001$). With a cut-off value of > 13.75, RDW was able to predict patients requiring invasive treatment [Sensitivity = 75.86%, Specificity = 63.87%, AUC (95% CI) = 0.657 (0.580–0.734), $p<0.001$].

Conclusiosn RDW, which is an inexpensive and readily-available parameter, may be a supportive measure in the prediction of the clinical severity of diverticulitis. Together with other clinical and laboratory data, RDW could help identify patients with worse prognosis, facilitating appropriate decisions and precautions in their management.

Keywords Diverticulitis, Biomarkers, Red cell distribution width, C-reactive protein, Prognosis

Introduction

Diverticular disease is an under-appreciated prevalent health problem that causes a decline in health-related quality of life due to inflamed bulging tissue pockets in the bowel [1]. While the prevalence is approximately 10% until the fifth decade of life, it rises up to 60–70% in older age [2]. Although the majority of patients with diverticula remain asymptomatic, 25% experience non-specific symptoms and around 5% experience acute diverticulitis [3].

Diverticulitis can manifest with mild to severe symptoms, creating a broad range of findings that can result in self-limiting disease or life-threatening conditions such as abscess formation, sepsis, or perforation requiring emergency surgery [1]. The ability to accurately predict the severity of diverticulitis and identify patients who may require surgical intervention remains an ongoing challenge in clinical practice. Although various diagnostic tools exist [4], there is a need for accessible and reliable biomarkers that can assist in clinical decision-making. The Hinchey Classification was established in

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1978 to classify diverticular perforations [5]. While it provides guidance for surgical management, it has limitations in predicting which patients may benefit from conservative versus invasive treatment [1, 5].

Chronic low-grade inflammation is thought to play a central role in the pathogenesis and progression of diverticulitis [6, 7]. Red cell distribution width (RDW) is a commonly used, easily and inexpensively obtained hemogram parameter that measures the degree of erythrocyte anisocytosis, reflecting the variability in the size of circulating erythrocytes [8, 9]. Initially used to differentiate iron deficiency anemia from thalassemia, RDW has emerged as a potential marker of systemic inflammation and oxidative stress [10–13]. Growing evidence suggests that RDW is associated with disease activity and prognosis in various gastrointestinal conditions, including irritable bowel syndrome, inflammatory bowel disease, and acute pancreatitis [14, 15]. Despite these findings, few studies have investigated the relationship between RDW and diverticulitis [16]. Given that systemic inflammation and oxidative stress play key roles in the pathogenesis of diverticulitis, RDW may serve as a useful marker for assessing disease severity and guiding treatment decisions. Further research is warranted to determine its clinical utility in this context.

Therefore, this study aims to investigate the relationship between RDW along other inflammatory markers and some clinical features with the clinical and radiological severity of acute diverticulitis.

Materials and methods

Study design and participants

A cross-sectional study was performed in patients with a diagnosis of acute diverticulitis confirmed by radiological imaging and colonoscopy examination at the Necmettin Erbakan University, Meram Faculty of Medicine, Department of General Surgery, from January 2010 to December 2020. Participants under 18 years of age, pregnant women, those with kidney transplantation, known or suspect hematologic diseases, active infection (including hepatitis), malignancy, autoimmune disease, thyroid gland disease, rheumatologic diseases, and kidney and liver dysfunction, and alcohol, tobacco or drug users were excluded. In addition, patients with a history of glucocorticoid therapy in the last 6 months, those with a history of venous thrombosis in the last 6 months, and those with a history of blood transfusion in the last 3 months were not included in the analyses.

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Non-Pharmaceutical and Non-Medical Device Research Ethics Committee of Necmettin Erbakan University (Decision date: 18.06.2024, decision no: 2021/3311). The requirement for individual informed consent was waived by the Non-Pharmaceutical and Non-Medical Device Research Ethics Committee of Necmettin Erbakan University due to the retrospective nature of the study and the use of anonymized data.

Data collection and definitions

The medical records were examined to assess the following data of patients with diverticulitis: age and sex, comorbidity status, localization, Hinchey class, type of treatment administered, type of surgery performed (if surgical treatment was performed), length of stay in hospital, and laboratory findings.

Radiological diverticulitis severity was determined by the Hinchey classification [5]. Patients were classified into four classes: I: Localized abscess (paracolonic), II: Pelvic, intra-abdominal, or retroperitoneal abscess, III: Generalized purulent peritonitis, IV: Generalized fecal peritonitis [5]. Comparisons in this study were performed for Class I versus Classes II-IV.

The approach to the diagnosis and treatment for acute diverticulitis was conducted according to the guidelines of the American Society of Colon and Rectal Surgeons [17]. Initially, all patients received conservative antibiotic therapy. The need for surgical intervention was defined as cases requiring immediate surgery due to complications (e.g., perforation, abscess) or failure of conservative management, as determined by the clinical team based on patient condition and radiological findings. The clinical severity of diverticulitis was classified according to the treatment applied, in two groups: the first group (invasive group) included patients who required surgery or interventional radiological procedures at any stage of the treatment process. The second group (conservative group) included patients for whom medical treatment alone was sufficient for treatment.

We examined laboratory results routinely ordered when patients were diagnosed with diverticulitis. All laboratory measurements including complete blood count (CBC) and C-reactive protein (CRP) level were performed in the certified biochemistry laboratory of our hospital using calibrated devices and with manufacturer protocols and kits. Hemoglobin level, platelet count, white blood cell (WBC) count and red cell distribution width (RDW) were extracted from routine CBC data.

Outcomes

The primary outcome of the study was to investigate independent variables associated with the clinical and radiological severity of the diverticulitis.

Statistical analysis

For the statistical analysis, we used the IBM SPSS v25.0 software (IBM, Armonk, NY, USA). Statistical significance was set at a p-value of less than 0.05. To assess the

normality of the data distribution, histograms and Q-Q plots were employed. Descriptive statistics were presented in different formats based on data types. For continuous variables that followed a normal distribution, mean and standard deviation were used. For continuous variables that did not follow a normal distribution, median with 25th and 75th percentiles (interquartile range) were used. Categorical variables were summarized using frequencies and percentages. For the analysis of continuous variables, different tests were applied depending on the normality of their distribution. Normally distributed data were analyzed with the Student's t-test, while the Mann-Whitney U test was utilized for non-normally distributed data. Categorical variables were analyzed using the chi-square test, Fisher's exact test, or Fisher-Freeman-Halton test, as appropriate. Spearman correlation coefficients were used to assess the relationships between variables, as this method is suitable for non-parametric data that do not assume a normal distribution. The predictive performance of RDW was assessed using receiver operating characteristic (ROC) curve analysis. To identify independent predictors of diverticulitis and the effectiveness of different treatment methods, multivariable logistic regression was performed. Variables that were found to be statistically significant in univariate analysis were included in the multivariable model to adjust for potential confounders and identify independent predictors. Missing data were handled by excluding incomplete records from the analysis to ensure the reliability and accuracy of the results.

Results

A total of 250 patients with diverticulitis were included in the study. The Hinchey class I versus class II-IV comparison is summarized in Table 1. Briefly, 187 patients had class I and 63 patients had class II-IV diverticulitis. The groups were similar in terms of age ($p = 0.376$) and sex distribution ($p = 0.244$). The class II-IV group had significantly higher frequencies of patients with coronary artery disease ($p = 0.002$). As anticipated, this group also had higher frequencies of receiving surgical treatment (compared to medical treatment) ($p < 0.001$), interventional radiology treatment ($p = 0.037$), anterior resection ($p < 0.001$), Hartmann procedure ($p < 0.001$) and segmental resection ($p = 0.001$). The WBC ($p = 0.006$), platelet ($p = 0.002$) and CRP ($p < 0.001$) levels of patients with class II-IV diverticulitis were significantly higher than class I patients. Hinchey stage had weak positive correlations with WBC ($r = 0.190$, $p = 0.003$), platelet ($r = 0.177$, $p = 0.005$) and CRP ($r = 0.400$, $p < 0.001$) values (Table 2).

High platelet (OR: 1.007, 95% CI: 1.003–1.011, $p = 0.001$) and high CRP (OR: 1.012, 95% CI: 1.008–1.017, $p < 0.001$) levels were independently associated with Class II-IV diverticulitis after adjusting for coronary artery disease presence (Table 3).

In overall evaluation, we determined that 58 patients had received invasive treatment and 192 patients had received medical (conservative) treatment. These groups were again similar in terms of age ($p = 0.290$) and sex distribution ($p = 0.400$). The percentage of patients with coronary artery disease ($p = 0.006$) and length of hospital stay ($p < 0.001$) were significantly higher among patients receiving invasive treatment. Notably, diverticula presence in the descendant colon was significantly more common in the conservative treatment group ($p = 0.029$). In the invasive treatment group, platelet ($p = 0.043$), RDW ($p < 0.001$) and CRP ($p = 0.002$) levels were significantly higher, while hemoglobin level was significantly lower ($p = 0.017$) (Table 4).

RDW was able to predict patients requiring invasive treatment. The best cut-off value with highest predictive performance was >13.75 [Sensitivity = 75.86%, Specificity = 63.87%, AUC (95% CI) = 0.657 (0.580–0.734), $p < 0.001$] (Table 5; Fig. 1).

Stage II-IV Hinchey classification (OR: 9.550, 95% CI: 3.987–22.876, $p < 0.001$) and high (>13.75) RDW (OR: 4.944, 95% CI: 2.055–11.894, $p < 0.001$) were independently associated with receipt of invasive (surgery or interventional radiology) treatment after adjustment for coronary artery disease (Table 6).

Discussion

In the presence of diverticulosis, the lifetime risk of diverticulitis ranges from 10 to 25% [18], demonstrating the need for inexpensive tools to assess risks in these patients. Identifying and classifying patients with acute diverticulitis for medical or surgical treatment is crucial [19]. Recent studies have explored ways to further classify management, such as distinguishing patients who can be treated as outpatients from those who require inpatient care [19]. Accurately predicting the initial severity of the disease is essential for safely categorizing patients according to their treatment needs. Investigating the utility of readily available and inexpensive parameters routinely used in clinical practice is a reliable approach to address such challenges. Due to their wide recognition among physicians and well-established use scenarios, these parameters may be used safely and easily to predict the clinical severity and prognosis of acute diverticulitis. In this study, comorbidity, high WBC, and high CRP were independent predictors of radiologically severe diverticulitis, while Stage II-IV Hinchey class and high RDW were independent predictors of clinically severe diverticulitis. CRP showed the highest positive correlation with radiological severity. RDW predicted the need for invasive treatment with 75.86% sensitivity and 63.87% specificity. To our knowledge, this is the first study to report a

Table 1 Summary of variables with regard to Hinchey classification

	Total ($n=250$)	Hinchey classification		*p*
		Class I ($n=187$)	Class II - IV ($n=63$)	
Age (years)	58.70 ± 15.75	58.19 ± 15.98	60.22 ± 15.07	0.376†
Sex				
Male	141 (56.40%)	101 (54.01%)	40 (63.49%)	0.244#
Female	109 (43.60%)	86 (45.99%)	23 (36.51%)	
Comorbidities	107 (42.80%)	79 (42.25%)	28 (44.44%)	0.760#
Hypertension	65 (26.00%)	48 (25.67%)	17 (26.98%)	0.968#
Diabetes mellitus	38 (15.20%)	27 (14.44%)	11 (17.46%)	0.708#
Cerebrovascular disease	3 (1.20%)	2 (1.07%)	1 (1.59%)	1.000§
Other neurologic diseases	5 (2.00%)	4 (2.14%)	1 (1.59%)	1.000§
Coronary artery disease	17 (6.80%)	7 (3.74%)	10 (15.87%)	**0.002§**
Other cardiac diseases	16 (6.40%)	14 (7.49%)	2 (3.17%)	0.371§
Respiratory system diseases	22 (8.80%)	19 (10.16%)	3 (4.76%)	0.293#
Thyroid diseases	9 (3.60%)	7 (3.74%)	2 (3.17%)	1.000§
Chronic renal failure	3 (1.20%)	1 (0.53%)	2 (3.17%)	0.157§
Rheumatoid arthritis	2 (0.80%)	0 (0.00%)	2 (3.17%)	0.063§
Location (1)				
Cecum	9 (3.60%)	7 (3.74%)	2 (3.17%)	1.000§
Ascending colon	7 (2.80%)	7 (3.74%)	0 (0.00%)	0.197§
Transverse colon	1 (0.40%)	1 (0.53%)	0 (0.00%)	1.000§
Splenic flexure	1 (0.40%)	0 (0.00%)	1 (1.59%)	0.252§
Descending colon	64 (25.60%)	54 (28.88%)	10 (15.87%)	0.060#
Sigmoid colon	182 (72.80%)	130 (69.52%)	52 (82.54%)	0.065#
Rectosigmoid	8 (3.20%)	5 (2.67%)	3 (4.76%)	0.420§
Rectum	7 (2.80%)	6 (3.21%)	1 (1.59%)	0.683§
Colorectal	3 (1.20%)	3 (1.60%)	0 (0.00%)	0.574§
Treatment (1)	250 (100.00%)	187 (100.00%)	63 (100.00%)	0.342§
Only medical	192 (76.80%)	165 (88.23%)	27 (42.85%)	**< 0.001#**
Surgery	52 (20.80%)	20 (10.69%)	32 (50.79%)	**< 0.001#**
Interventional radiology	6 (2.40%)	2 (1.07%)	4 (6.35%)	**0.037§**
Type of surgery (1)				
Anterior resection	18 (7.20%)	5 (2.67%)	13 (20.63%)	**< 0.001§**
Hartmann procedure	11 (4.40%)	0 (0.00%)	11 (17.46%)	**< 0.001§**
Diagnostic laparotomy	9 (3.60%)	6 (3.21%)	3 (4.76%)	0.696§
Left colectomy	7 (2.80%)	3 (1.60%)	4 (6.35%)	0.070§
Right colectomy	6 (2.40%)	3 (1.60%)	3 (4.76%)	0.170§
Low anterior resection	5 (2.00%)	4 (2.14%)	1 (1.59%)	1.000§
Segmental resection	5 (2.00%)	0 (0.00%)	5 (7.94%)	**0.001§**
Subtotal colectomy	4 (1.60%)	2 (1.07%)	2 (3.17%)	0.264§
Ileostomy	3 (1.20%)	1 (0.53%)	2 (3.17%)	0.157§
Abscess drainage	2 (0.80%)	0 (0.00%)	2 (3.17%)	0.063§
Loop colostomy	1 (0.40%)	1 (0.53%)	0 (0.00%)	1.000§
Total colectomy	1 (0.40%)	0 (0.00%)	1 (1.59%)	0.252§
Length of stay in hospital (days)	5 (4–8)	5 (3–7)	5 (4–8)	0.069‡
WBC ($x10^9$/L)	10.66 (7.84–14.00)	10.03 (7.50–13.70)	11.64 (8.59–15.70)	**0.006‡**
Hemoglobin (g/dL)	13.63 ± 1.96	13.67 ± 1.96	13.52 ± 1.94	0.598†
Platelet ($x10^9$/L)	271.46 ± 84.75	261.67 ± 78.99	300.37 ± 94.74	**0.002†**
RDW (%)	13.6 (13.0–14.8)	13.5 (13.0–14.8)	13.9 (12.9–15.2)	0.440‡
C-reactive protein (mg/L)	44.51 (7.55–120.34)	27.50 (4.60–89.28)	120.34 (45.50–179.00)	**< 0.001‡**

Descriptive statistics were presented using mean ± standard deviation for normally distributed continuous variables, median (25th percentile – 75th percentile) for non-normally distributed continuous variables and frequency (percentage) for categorical variables. (1) Patients may have more than one of the followings. † Student's t test, ‡ Mann Whitney U test, # Chi-square test, § Fisher's exact test

Abbreviations; RDW: Red cell distribution width, WBC: White blood cell

Table 2 Correlations between age, laboratory measurements and Hinchey classification

	r	*p*
Age (years)	0.049	0.442
WBC (x10^9/L)	0.190	**0.003**
Hemoglobin (g/dL)	-0.033	0.603
Platelet (x10^9/L)	0.177	**0.005**
RDW (%)	0.061	0.337
C-reactive protein (mg/L)	0.400	**< 0.001**

Abbreviations; r: Spearman correlation coefficient, RDW: Red cell distribution width, WBC: White blood cell

significant relationship between RDW and diverticulitis severity, as well as its predictive value for surgical or interventional treatment. Although RDW was statistically associated with the need for invasive treatment, its moderate sensitivity and specificity limit its clinical value as a standalone biomarker. It is more appropriate to consider RDW as a supplementary indicator that may support clinical judgment when combined with radiological and laboratory findings.

Various studies have explored predictive factors for diverticulitis severity. For instance, Harmantepe et al. found RDW and the monocyte-to-lymphocyte ratio to be higher in asymptomatic diverticulosis patients, while the neutrophil-to-lymphocyte ratio and systemic immune inflammation index varied across Hinchey groups [16]. In another study, symptomatic patients with diverticulosis exhibited higher relative expression of tumor necrosis factor alpha compared to asymptomatic patients [6]. A meta-analysis by Bolkenstein et al. found high CRP, WBC, and comorbidity to be risk factors for complicated diverticulitis (20), supporting our results. A systematic review also identified predictors of severe diverticulitis, including first-episode cases, comorbidities, NSAID or steroid use, high CRP, and radiological severity [1].

Similar to our findings, Kechagias et al. reported that CRP and Hinchey classification independently predicted severe acute diverticulitis, with a CRP cut-off of 170 mg/L distinguishing between severe and mild cases [20]. Other studies have investigated different risk models, such as the association of treatment failure with elevated urea levels, severe diverticulitis detection via CT, advanced age, leukocyte shift, and fever [21]. Additionally, clinically severe right-colon diverticulitis has been linked to older age, computed tomography detected complications, rebound tenderness, high alkaline phosphatase, and high CRP [22]. Makela et al. found a CRP cut-off of 149.5 mg/L to distinguish uncomplicated from complicated diverticulitis, with 65% specificity and 85% sensitivity [23]. Inflammatory markers have also been associated with surgical risks and poor outcomes. A study on sigmoid diverticulitis reported that a CRP level below 50 mg/L had a low likelihood of perforation, while levels above 200 mg/L were strongly associated with perforation [24]. Despite their predictive value, studies caution that CRP and similar markers alone cannot fully exclude severe disease [25], which is also a concern for RDW due to potential confounders like anemia. Inflammation indices such as neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio have been linked to diverticulitis severity [26], supporting the use of CBC parameters like RDW. Additionally, lipopolysaccharide-binding protein has been suggested as a stronger predictor of the need for invasive treatment than CRP and interleukin-6 [27]. Despite existing research on traditional markers, further studies are needed to evaluate additional parameters for their role in predicting diverticulitis severity and outcomes.

Taken comprehensively, the literature and our results indicate that the reported markers for predicting the severity and prognosis of diverticulitis are closely associated with inflammation, but there are still challenges that limit the use of these markers for management decisions. The most likely reasons for the inconsistencies are the differences in the variables investigated, the inclusion and exclusion criteria of the participants, and the criteria for the severity of diverticulitis across studies. In the current study, we investigated factors related to both the radiological severity of diverticulitis (Hinchey classification) and the clinical severity (based on required treatment). We therefore believe our findings to be highly valuable as they present promising results for an easily-accessible parameter (RDW) that can provide guidance in the management of patients with diverticulitis and the decision for surgical intervention. Although RDW was unassociated with Hinchey classification, it successfully predicted clinical severity. It is possible that the anisocytosis observed in RDW may reflect systemic inflammation or

Table 3 Independent predictors of Hinchey stage II-IV diverticulitis, multivariable logistic regression analysis ($n = 250$)

	β coefficient	**Standard error**	***p***	**Exp(β)**	**95% CI for Exp(β)**	
Coronary artery disease	1.472	0.611	**0.016**	4.359	1.315	14.449
WBC (x10^9/L)	-0.073	0.048	0.126	0.929	0.846	1.021
Platelet (x10^9/L)	0.007	0.002	**0.001**	1.007	1.003	1.011
C-reactive protein (mg/L)	0.012	0.002	**< 0.001**	1.012	1.008	1.017
Constant	-3.251	0.710	< 0.001	0.039		

Nagelkerke $R^2 = 0.300$

Abbreviations; CI: Confidence interval, RDW: Red cell distribution width, WBC: White blood cell

Table 4 Summary of variables with regard to treatment

	Treatment		*p*
	Invasive (*n* = 58)	Conservative (*n* = 192)	
Age (years)	60.62 ± 15.47	58.12 ± 15.82	0.290†
Sex			
Male	36 (62.07%)	105 (54.69%)	0.400#
Female	22 (37.93%)	87 (45.31%)	
Comorbidities (1)	29 (50.00%)	78 (40.63%)	0.206#
Hypertension	18 (31.03%)	47 (24.48%)	0.408#
Diabetes mellitus	8 (13.79%)	30 (15.63%)	0.895#
Cerebrovascular disease	0 (0.00%)	3 (1.56%)	1.000§
Other neurologic diseases	1 (1.72%)	4 (2.08%)	1.000§
Coronary artery disease	9 (15.52%)	8 (4.17%)	**0.006§**
Other cardiac diseases	3 (5.17%)	13 (6.77%)	1.000§
Respiratory system diseases	3 (5.17%)	19 (9.90%)	0.396#
Thyroid diseases	2 (3.45%)	7 (3.65%)	1.000§
Chronic renal failure	2 (3.45%)	1 (0.52%)	0.135§
Rheumatoid arthritis	0 (0.00%)	2 (1.04%)	1.000§
Location (1)			
Cecum	3 (5.17%)	6 (3.13%)	0.437§
Ascending colon	1 (1.72%)	6 (3.13%)	1.000§
Transverse colon	0 (0.00%)	1 (0.52%)	1.000§
Splenic flexure	1 (1.72%)	0 (0.00%)	0.232§
Descending colon	8 (13.79%)	56 (29.17%)	**0.029#**
Sigmoid colon	45 (77.59%)	137 (71.35%)	0.443#
Rectosigmoid	1 (1.72%)	7 (3.65%)	0.685§
Rectum	2 (3.45%)	5 (2.60%)	0.665§
Colorectal	0 (0.00%)	3 (1.56%)	1.000§
Hinchey classification			
Class I	23 (39.66%)	164 (85.42%)	**< 0.001¶**
Class II	22 (37.93%)	27 (14.06%)	
Class III	11 (18.97%)	1 (0.52%)	
Class IV	2 (3.45%)	0 (0.00%)	
Length of stay in hospital (days)	6 (4–9)	5 (3–6)	**< 0.001‡**
WBC (x10^9/L)	10.92 (8.19–15.48)	10.50 (7.81–14.00)	0.548‡
Hemoglobin (g/dL)	13.10 ± 2.09	13.79 ± 1.89	**0.017†**
Platelet (x10^9/L)	296.07 ± 111.69	263.98 ± 73.43	**0.043†**
RDW (%)	14.25 (13.8–15.4)	13.4 (12.9–14.6)	**< 0.001‡**
C-reactive protein (mg/L)	87.50 (21.50–191.17)	41.18 (5.20–106.68)	**0.002‡**

Descriptive statistics were presented using mean ± standard deviation for normally distributed continuous variables, median (25th percentile – 75th percentile) for non-normally distributed continuous variables and frequency (percentage) for categorical variables. † Student's t test, ‡ Mann Whitney U test, # Chi-square test, § Fisher's exact test, ¶ Fisher-Freeman-Halton test

Abbreviations; RDW: Red cell distribution width, WBC: White blood cell

oxidative stress, both of which are known to play a significant role in the pathophysiology of diverticulitis. Increased oxidative stress and inflammatory cytokines may alter red blood cell production and maturation, leading to increased variability in cell size, which would be reflected in the RDW. This could potentially explain the elevated RDW levels observed in patients with more severe diverticulitis, as systemic inflammation and oxidative stress are often associated with higher disease severity. However, it must be noted that the specificity and sensitivity values are not at an optimal level for a biomarker. Although we used Hinchey classification based on CT imaging to assess disease severity, we did not directly compare RDW's predictive ability to that of radiologic parameters. Future studies should explore whether RDW offers additive value when used alongside imaging data. Alongside RDW, the Hinchey classification independently predicted the necessity for invasive treatment. While CRP and platelet levels did not significantly predict treatment approach, they independently predicted radiological severity. taken together, our results suggest that RDW, CRP and platelet levels may be utilized jointly when making treatment decisions, as supported by some previous studies. While RDW may have

Table 5 Performance of RDW to predict invasive treatment, ROC curve analysis

	RDW
Cut-off	> 13.75
Sensitivity	75.86%
Specificity	63.87%
Accuracy	66.67%
PPV	38.94%
NPV	89.71%
AUC (95% CI)	0.657 (0.580–0.734)
p	**< 0.001**

Abbreviations; AUC: Area under ROC curve, CI: Confidence interval, NPV: Negative predictive value, PPV: Positive predictive value, RDW: Red cell distribution width, ROC: Receiver operating characteristic

potential implications for long-term outcomes, such as recurrence or complications, our study was not designed to assess these aspects. However, due to the cross-sectional design of this study, we were not able to assess recurrence or track long-term outcomes. Prospective studies with follow-up are essential to evaluate RDW's prognostic value over time. Future prospective studies with extended follow-up periods are needed to clarify whether RDW can serve as a predictor of long-term outcomes. We believe that future studies should aim to: (i) establish a universally accepted classification for the severity of diverticulitis, (ii) collaborate on inclusion and exclusion criteria for participants, (iii) investigate a wide range of biomarkers along with RDW, and (iv) examine the long-term outcomes of treatments and the prognosis of the disease.

Despite the high patient count and broad inclusion of subjects, the results have limited generalizability particularly to different Hinchey classes, as we were able to analyze only two groups based on this classification (class I versus class II-IV). The retrospective design limits the reliability of some data that were based on hospital records (in spite of the fact that these were electronic records) and retrospective analysis precludes the inclusion of additional biomarkers, clinical variables, and long-term outcomes such as recurrence, complications, and mortality. If a group of patients with diverticulosis had been included, the results of patients with

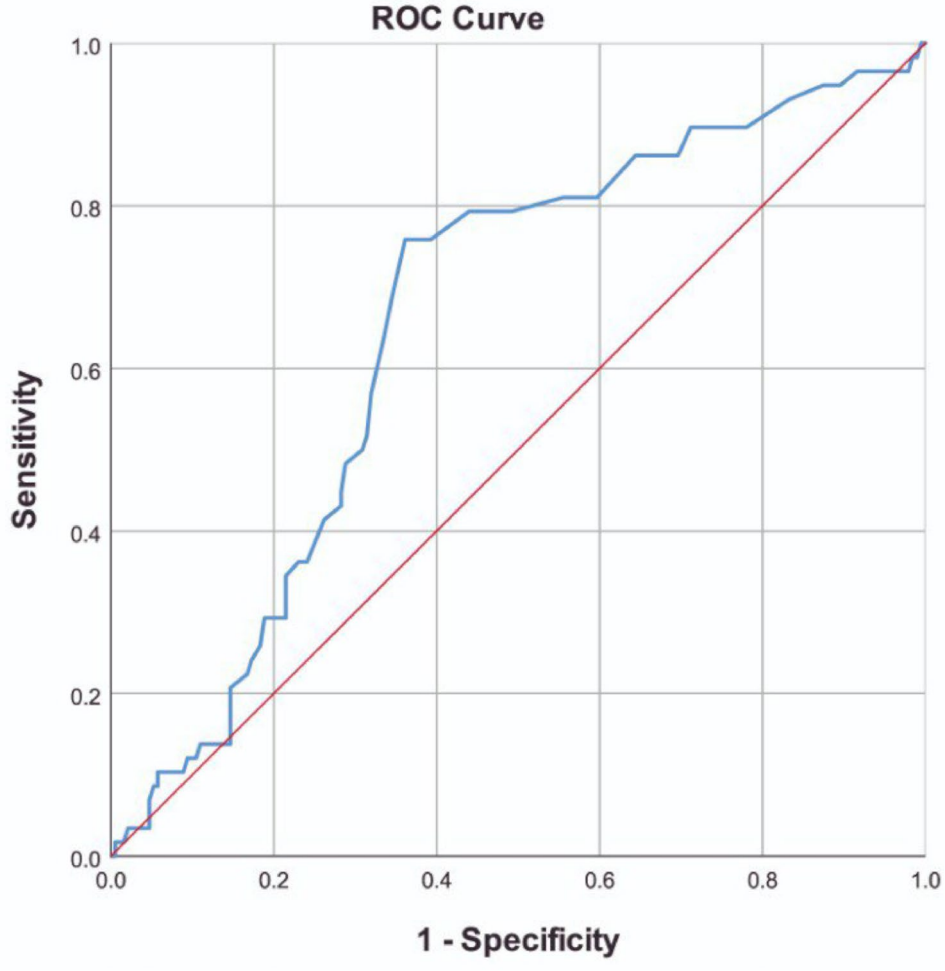

Fig. 1 ROC curve of red cell distribution width to predict invasive treatment (surgery or interventional radiology)

Table 6 Independent predictors of the invasive treatment, multivariable logistic regression analysis ($n = 250$)

	β coefficient	Standard error	*p*	Exp(β)	95% CI for Exp(β)	
Coronary artery disease	0.275	0.699	0.695	1.316	0.334	5.184
Descending colon	-0.618	0.506	0.222	0.539	0.200	1.454
Hinchey classification, Class II-IV	2.257	0.446	**< 0.001**	9.550	3.987	22.876
Hemoglobin (g/dL)	-0.026	0.110	0.814	0.975	0.786	1.208
Platelet ($x10^9$/L)	0.005	0.002	0.059	1.005	1.000	1.010
RDW (%), > 13.75	1.598	0.448	**< 0.001**	4.944	2.055	11.894
C-reactive protein (mg/L)	0.002	0.002	0.492	1.002	0.997	1.006
Constant	-4.054	1.877	0.031	0.017		

Nagelkerke $R^2 = 0.439$

Abbreviations; CI: Confidence interval, RDW: Red cell distribution width

diverticulitis could have been compared to these patients to understand the variations between these groups and the utility of examined parameters in distinguishing cases. Potential confounders that could affect RDW levels, such as iron deficiency, anemia, chronic diseases, malnutrition or other factors, were not evaluated. While we excluded patients with known comorbidities, we did not have access to laboratory data on iron status, renal function, or nutritional markers—all of which may affect RDW. This limitation should be kept in mind when interpreting our results. The exclusion of these factors may represent a limitation in the interpretation of the results. Additionally, the considerable differences in patient numbers between treatment groups may have affected the reliability of statistical comparisons in this regard. Additionally, since this study only included patients with confirmed diverticulitis, we were not able to compare RDW levels to those of a healthy or non-diverticulitis population. This limits our ability to define a general reference range or threshold for RDW in broader clinical settings.

Conclusions

Our data showed that high platelet count and elevated CRP levels were independent risk factors associated with higher radiological severity of diverticulitis. High Hinchey class and elevated RDW levels were independent risk factors associated with the necessity for invasive treatment. RDW may be utilized to support the prediction of the clinical severity of diverticulitis. Surgeons should consider the possibility of a worse prognosis in patients with these risk factors and take appropriate precautions in their management.

Author contributions

Conceptualization, M.Y.K. and M.A.Y.; methodology, M.Y.K. and M.A.Y.; software, M.Y.K. and M.A.Y.; validation, M.Y.K. and M.A.Y.; formal analysis, M.Y.K., M.A.Y. and A.G.D.; investigation, M.Y.K. and M.A.Y.; resources, M.Y.K. and M.A.Y.; data curation, M.Y.K., M.A.Y. and A.G.D.; writing—original draft preparation, M.Y.K. and M.A.Y.; writing—review and editing, M.Y.K., M.A.Y., S.S.T. and A.G.D.; visualization, M.Y.K., M.A.Y. and S.S.T.; supervision, M.Y.K., M.A.Y. and S.S.T.; project administration, M.Y.K. and M.A.Y. All authors have read and agreed to the published version of the manuscript.

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Data availability

All the data are available upon request from the corresponding author.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Non-Pharmaceutical and Non-Medical Device Research Ethics Committee of Necmettin Erbakan University (Decision date: 18.06.2024, decision no: 2021/3311). The requirement for individual informed consent was waived by the Non-Pharmaceutical and Non-Medical Device Research Ethics Committee of Necmettin Erbakan University due to the retrospective nature of the study and the use of anonymized data.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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