TPM Vol. 32, No. S, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

"RED CELL DISTRIBUTION WIDTH AS A MARKER OF DISEASE ACTIVITY AND ANEMIA IN INFLAMMATORY BOWEL DISEASE: A RETROSPECTIVE ANALYSIS"

[1]DR.S.SABEENA, [2]DR.VENKATRAGHAVAN.ATM, [3]DR.ANUSUYA
[1]FINAL YEAR POSTGRADUATE, DEPARTMENT OF PATHOLOGY, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, THANDALAM, KANCHIPURAM DIST. 602105, TAMIL NADU, INDIA
[2]ASSISTANT PROFESSOR, DEPARTMENT OF PATHOLOGY, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, THANDALAM, KANCHIPURAM DIST. 602105, TAMIL NADU, INDIA.
[3]SENIOR LECTURER, DEPARTMENT OF PROSTHODONTICS AND CROWN & BRIDGE, SREE BALAJI DENTAL COLLEGE & HOSPITAL, CHENNAI, INDIA

Abstract
Background:
Inflammatory bowel disease (IBD), thatinvolves“UC (Ulcerative Colitis)” and “CD (Crohn’s Disease)”, is a chronic inflammatory disorder of the gastrointestinal tract. Laboratory indicators, including “C-reactive protein (CRP)”, “ESR (Erythrocyte Sedimentation Rate)”, and haemoglobin (Hb), are essential for assessing disease activity. Recent research indicates that “RDW (Red Cell Distribution Width)”, a metric of erythrocyte size variability, may function as an auxiliary inflammatory marker in IBD. This study assesses the correlation between RDW and disease activity in patients with IBD.
Methods:
This retrospective analysis encompassed 120 patients with IBD (90 with UC and 30 with CD), classified as per the disease activity and anaemia status. Laboratory data, including RDW, CRP, ESR, platelet count (PLT), and haemoglobin levels, were evaluated. Statistical analyses, such as “Student's t-test”, “Pearson correlation”, and “chi-square test”, had been performed, with $p < 0.05$ that indicate significance
Results:
RDW levels were markedly elevated in active IBD vs to remission ($p = 0.048$). Anaemic IBD patients exhibited elevated levels of RDW, CRP, ESR, and PLT in comparison to non-anaemic patients ($p < 0.001$ for all indicators). The data indicate a strong relationship between RDW and inflammation in IBD, underscoring its potential as a cost-effective index of disease activity.
Conclusion:
RDW is significantly associated with IBD activity and anemia status, making it a potential adjunctive biomarker for disease monitoring. Given its availability in routine blood tests, RDW could be a valuable tool for predicting disease flares and assessing treatment response. Additional prospective studies are needed to corroborate these outcomes.
Keywords: Inflammatory bowel disease, red cell distribution width, anemia, inflammatory markers, disease activity.

INTRODUCTION

IBD is a chronic disorder of the gastrointestinal system marked by alternating phases of exacerbation and remission (1). It principally comprises two subtypes: CD and UC. UC can becharacterized by inflammation limited to the colonic mucosa, whereas CDinvolves transmural inflammation that can impact any portion of the gastrointestinal tract.
In the management of IBD, laboratory indicators including hemoglobin (Hb) levels, platelet count, and inflammatory markers—specifically ESR and CRP—are essential for evaluating disease activity and monitoring treatment efficacy.Currentinvestigationsspecify that RDW, a measure of erythrocyte size variability, may function as an additional inflammatory marker in inflammatory bowel disease (5-7).
RDW indicates the variability in erythrocyte dimensions (anisocytosis) within peripheral blood. A normal complete blood count automatically records the “RDW by dividing the standard deviation of erythrocyte volume

distribution by the mean corpuscular volume (MCV) and multiplying by 100". It is frequently utilized in the diagnosis of anemias related to deficiencies in iron, vitamin B12, or folic acid. Moreover, its diagnostic capabilities have been investigated in diseases such as colon cancer and celiac disease (9-11).

Recent studies have highlighted the clinical importance of RDW in evaluating illness severity and outcomes across numerous conditions, including "renal failure", "cardiovascular and respiratory diseases", "sepsis", "malignancies", and "autoimmune disorders" (11,12). It is acknowledged as a significant predictor of death in cardiovascular disorders and demonstrates predictive significance in assessing survival rates among hospitalized patients and persons aged 45 and older. The correlation between RDW and survival is thought to be affected by systemic variables, including inflammation and oxidative stress, which disturb erythrocyte homeostasis (14). Increased oxidative stress diminishes erythrocyte longevity, resulting in a higher prevalence of immature erythrocytes in circulation and, therefore, greater anisocytosis (15). Moreover, the association between systemic inflammation and RDW underscores its significance as a pertinent inflammatory marker (11).

This study examined RDW values in IBD patients during active disease stages and remission. Our objective was to evaluate the efficacy of RDW as a dependable indicator for tracking disease activity and forecasting recurrence of IBD.

METHODS

This study included 120 patients diagnosed with inflammatory bowel disease (IBD), either hospitalized or receiving outpatient care. Patient medical records were reviewed retrospectively. Individuals with malignancies, rheumatic disorders, acute infections, cardiovascular problems, or those who failed to comply with follow-up had been notinvolved. The study population involved 90 patients (75%) diagnosed with ulcerative colitis (UC) and 30 individuals (25%) diagnosed with Crohn's disease.

Laboratory parameters, including "serum RDW", "CRP", "ESR", "leukocyte"as well as"platelet counts", "Hb concentration", "MPV", "MCV", and "iron (Fe)" levels, were determined during both active and remission phases. Disease activity had beendeterminedby employing the "Mayo score" for UC and the "Crohn's Disease Activity Index (CDAI)" for CD. Disease severity classification was as follows:

- **UC (Mayo score):**
  - Remission: <3
  - Mild activity: 3–5
  - Moderate to severe activity: ≥5
- **Crohn's disease (CDAI):**
  - Remission: <150
  - Mild activity: 150–200
  - Moderate to severe activity: ≥200

Patients were considered in remission when their disease activity scores, clinical findings, and test results were within normal ranges. Anemia is characterized by hemoglobin levels below 12g/dL in females and below 13g/dL in males.

The "Ethics Committee of Saveetha Training and Research Hospital" accepted the study, ensuring adherence to ethical principles.

Statistical Analysis

The "Shapiro-Wilk""test had been employed to evaluate the normality of numerical variables. Student's t-test was utilized for comparisons between two independent groups with normally distributed" variables, whereas the paired t-test had been employed to assess differences between two dependent measurements. The Pearson correlation coefficient was employed to investigate numerical variable correlations, "while the chi-square test was employed for categorical variables. Data analysis was conducted utilizing SPSS for Windows version 22.0, with statistical significance set at $P<0.05$".

RESULTS

Table "1. General Characteristics of Patients with Ulcerative Colitis and Crohn's Disease

Characteristic	Ulcerative Colitis (n=90)	Crohn's Disease (n=30)	p-value
Gender (M/F)"	52/38	18/12	0.560
Age (years)	41.2 ± 13.8	38.1 ± 11.9	0.280
Disease Duration (months)	30.1 ± 44.2	27.5 ± 38.7	0.870
Disease Localization (n, %)			
- Proctitis	22 (24.4)	—	—

Characteristic	Ulcerative Colitis (n=90)	Crohn's Disease (n=30)	p-value
- Left-sided Colitis	38 (42.2)	—	—
- Pancolitis	30 (33.3)	—	—
- Terminal Ileitis	—	17 (56.7)	—
- Ileocolitis	—	13 (43.3)	—
Anemia (n, %)	33 (36.7)	13 (43.3)	0.400

Table "2. Comparative Analysis of Inflammatory Markers in IBD Patients Based on Disease Activity and Remission

Marker	Ulcerative Colitis (n=90)	p-value	Crohn's Disease (n=30)	p-value
	Activity	Remission		Activity
Hb (g/dL)	12.7±1.9	13.4±1.6	0.002*	12.6±2.0"
Htc (%)	38.9 ± 5.1	40.3 ± 4.4	0.005*	39.1 ± 5.8
WBC (10^3/mm^3)	8.5 ± 2.5	7.2 ± 1.9	0.001*	8.6 ± 2.1
PLT (10^3/mm^3)	293.6 ± 108.7	266.8 ± 80.5	0.004*	332.5 ± 112.3
ESR (mm/hr)	26.8 ± 25.2	13.4 ± 10.7	<0.001*	34.2 ± 20.9
CRP (mg/dL)	18.5 ± 35.9	4.0 ± 7.9	<0.001*	36.1 ± 47.8
RDW (%)	15.1 ± 2.8	14.4 ± 1.9	0.048*	15.7 ± 3.3

*p < 0.05 -Statistically significant

Table "3. Comparison of Inflammatory Markers in Active IBD Patients Based on Anemia Status

Marker	IBD Patients with Anemia (n=45")	IBD Patients without Anemia (n=75)	p-value
CRP (mg/dL)	39.2 ± 57.4	13.0 ± 18.3	0.003*
RDW (%)	16.5 ± 3.5	14.4 ± 2.0	<0.001*
ESR (mm/hr)	40.1 ± 30.2	19.8 ± 15.3	<0.001*
PLT (10^3/mm^3)	365.0 ± 130.5	266.2 ± 75.8	<0.001*

*p < 0.05,Statistically significant

DISCUSSION

IBD, which includes UC and CD, is defined by persistent gastrointestinal inflammation marked by episodes of discomfort and remission. Identifying dependable biomarkers for disease activity is essential for enhancing treatment methods. This study examined RDW as a prospective inflammatory measure in patients with IBD, along with traditional markers including CRP, ESR, Hb, PLT, and WBC count.

At present, there exists no definitive gold standard test for evaluating the activity, severity, and prognosis of IBD. A synthesis of clinical symptoms, laboratory indicators, imaging, endoscopy, and histological analysis is generally employed to assess disease activity. Recent studies have examined RDW as a possible inflammatory measure in IBD, specifically for evaluating disease activity and informing treatment decisions (6,7). Our data additional support this potential function of RDW.

RDW is consistently evaluated in complete blood counts and indicates the variability in erythrocyte size, rendering it a cost-effective parameter for clinical evaluation (8). It has conventionally been employed in diagnosing anemias resulting from deficits in iron, vitamin B12, or folic acid (17). Furthermore, RDW elevates in circumstances such as substantial blood loss, hemoglobinopathies, hemolyticanemia, and hemolysis (12,13). The precise processes connecting enhanced RDW with IBD activity remain unclear; nevertheless, chronic inflammation is thought to lead to inefficient erythropoiesis and heightened RDW "because of the premature release of immature erythrocytes into circulation.

Pro-inflammatory cytokines, that involves IL-1β, IL-6, IL-10, TNF-α, and interferon-γ, are produced by peripheral blood monocytes and intestine lamina propria mononuclear cells" in IBD. These cytokines induce anemia by promoting erythropoietin resistance and reducing erythrocyte lifetime through oxidative stress as well as lipid peroxidation. This facilitates erythrophagocytosis, diminishes iron recirculation, and results in functional iron

deficit despite sufficient iron reserves (19). Moreover, inflammation elevates hepcidin levels, resulting in diminished intestinal iron absorption and heightened blood loss, which further exacerbates elevated “RDW” and “anisocytosis” (13).

Our investigation revealed that RDW levels were markedly elevated in IBD patients during active disease relative to remission ($p=0.048$ for UC and p-value not computed for Crohn's due to a singular value comparison). These results correspond with other research, including that of Cakal et al. (5), which demonstrated that an RDW threshold of 14% exhibited a sensitivity (86%) and specificity (75%) for identifying active UC, whereas a 14.1% threshold for CD showed a sensitivity (78%) and specificity (63%).

As anticipated, inflammatory indicators including ESR, CRP, WBC, platelet counts had been markedly raised in active IBD. UC patients, ESR, CRP, platelet counts were markedly elevated in individuals with severe Mayo scores, but in CD patients, these markers were associated with moderate-to-severe CDAI scores. Contrary to some other research, however, there was no discernible relationship between RDW and disease activity scores (5,6). RDW levels were higher in Crohn's disease (14.9%) than in UC (14.3%), according to Clarke et al. (20), who attributed this disparity to anemia brought on by malabsorption. In order to distinguish CD from ulcerative colitis, another study found an RDW cut-off of 14.45% with sensitivity (70%) and specificity (56%) (7). Nevertheless, during the active phase of our investigation, no discernible variations in RDW or other inflammatory markers were found between CD and UC.

Anemia was associated with significantly higher RDW, CRP, ESR, and platelet counts among our active IBD patients ($p<0.001$ for RDW, ESR, and PLT; $p=0.003$ for CRP). These results suggest that anemia deteriorates as the seriousness of the disease increases. RDW had been found to be the best independent predictor of “disease activity in Crohn's patients without anemia by Song et al. (6), who also demonstrated that RDW related with disease activity in both anemic and non-anemic IBD patients”. CRP is still the most sensitive as well as specific indicator of CD activity, according to other research, even if RDW is a significant predictor of active UC (5,26).

According to our findings, both UC and Crohn's patients had significantly higher ESR, CRP, and RDW levels during active disease as opposed to remission. ESR, CRP, and illness severity were shown to be strongly correlated, however RDW and disease activity scores did not correlate. These results imply that traditional measures such as ESR as well as CRP are still more accurate in determining the severity of IBD, even though RDW may be helpful as a supportive inflammatory sign.

Other chronic diseases, such as autoimmune disorders, sepsis, cancer, and cardiovascular ailments, have a well-established correlation between RDW and inflammation. Our results further support RDW's clinical relevance in IBD and raise the possibility that it could be a readily available and reasonably priced marker for disease monitoring. The added use of RDW, however, may offer important insights into disease activity, anemia status, and overall prognosis, even though CRP and ESR continue to be the predominant inflammatory markers in clinical practice.

CONCLUSION

Our research confirms RDW's potential use as an inflammatory and prognostic marker by showing that it is markedly higher in patients with active IBD and anaemia. RDW might be a useful supplementary metric in the assessment of IBD activity because it is easily accessible as anelement of a standard CBC. Its function in therapy monitoring and long-term illness outcomes need more investigation.

Limitations and Future Directions

There are several limitations on this investigation. First, because of the small sample size, the results might not be as widely relevant as they could be. Second, the analysis did not adequately account for comorbidities and dietary inadequacies, which might have an effcet on RDW values. The importance of RDW in predicting IBD flares and treatment response has to be confirmed by future prospective studies with bigger populations and longitudinal follow-ups.

REFERENCE

1. Guan Q. A Comprehensive Review and update on the pathogenesis of inflammatory bowel disease. J Immunol Res 2019; 7247238.
2. Kulnigg S, Gasche C. Systematic review: managing anaemia in Crohn’s disease. Aliment Pharmacol Ther 2006; 24: 1507-23. 3. 4. 5. 6. 7. 8. 9.
3. Vermeire S, Van Assche G, Rutgeerts P. Laboratory markers in IBD: useful, magic, or unnecessary toys? Gut 2006; 55: 426-31.
4. Cabrera-Abreu J, Davies P, Matek Z, Murphy MS. Performance of blood tests in diagnosis of inflammatory bowel disease in a specialist clinic. Arch Dis Child 2004; 89: 69-71.

5. Cakal B, Akoz AG, Ustundag Y, Yalinkilic M, Ulker A, Ankarali H. Red cell distribution width for assessment of activity of inflammatory bowel disease. Dig Dis Sci 2009; 54: 842-
6. Song CS, Park Il D, Yoon MY, Seok HS, Park JH, Kim HJ, et al. Association between red cell distribution width and disease activity in patients with inflammatory bowel disease. Digest Dis Sci 2011; 57: 1033-
7. Arhan M, Önal KI, Taş A, Kurt M, Kalkan İH, Özin Y, et al. The role of red cell distribution width as a marker in inflammatory bowel disease. Turk J Med Sci 2011; 41: 227-34.
8. Evans TC, Jehle D. The red blood cell distribution width. J Emerg Med. 1991;
9. (Suppl 1): 71-4. Sategna GC, Scaglione N, Martini S. Red cell distribution width as a marker of coeliac disease: a prospective study. Eur J Gastroenterol Hepatol 2002; 14: 177-81.
10. Spell DW, Jones DV Jr, Harper WF, Bessman JD. The value of a complete blood count in predicting cancer of the colon. Cancer Detect Prev 2004; 28: 37-42.
11. Goyal H, Lippi G, Gjymishka A, John B, Chhabra R, May E. Prognostic significance of red blood cell distribution width in gastrointestinal disorders. World J Gastroenterol 2017; 23: 4879-91.
12. Lippi G, Mattiuzzi C, Cervellin G. Learning more and spending less with neglected laboratory parameters: the paradigmatic case of red blood cell distribution width. Acta Biomed 2017; 87: 323-8.
13. Felker GM, Allen LA, Pocock SJ, Shaw LK, McMurray JJV, Pfeffer MA, et al. Red cell distribution width as a novel prognostic marker in heart failure data from the CHARM program and the Duke databank. J Am Coll Cardiol 2007; 50: 41-7.
14. Patel KV, Ferrucci L, Ershler WB, Longo DL, Guralnik JM. Red cell distribution width and the risk of death in middle-aged and older adults. Arch Intern Med 2009; 169: 515-23.
15. Agarwal S. Red cell distribution width, inflammatory markers, and cardiorespiratory fitness: Results from the National Health and Nutrition Examination Survey. Indian Heart J 2012; 64: 380-7.
16. Oliveira AM, Cardoso FS, Rodrigues CG, Santos L, Martins A, de Deus JR, et al. Can red cell distribution width be used as a marker of crohn's disease activity? GE Port J Gastroenterol 2016; 23: 6-12.
17. Lippi G, Targher G, Montagnana M, Salvagno GL, Zoppini G, Guidi GS, et al. Relation between red blood cell distribution width and inflammatory biomarkers in a large cohort of unselected outpatients. Arch Pathol Lab Med 2009; 133: 628-32.
18. Strong SA, Pizarro TT, Klein JS, Cominelli F, Fiocchi C. Proinflammatory cytokines differentially modulate their own expression in human intestinal mucosal mesenchymal cells. Gastroenterology 1998; 114: 1244-56.
19. Schreiber S, Howaldt S, Schnoor M, Nikolaus S, Bauditz J, Gasché C, et al. Recombinant erythropoietin for the treatment of anemia in inflammatory bowel disease. N Engl J Med 1996; 334: 619-24.
20. Clarke K, Sagunarthy R, Kansal S. RDW as an additional marker in inflammatory bowel disease/undifferentiated colitis. Dig Dis Sci 2008; 53: 2521-3.