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The Study of Red Blood Cell Distribution Width (RDW) as a Prognostic Marker in Sepsis – An Observational Study

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ABSTRACT

Background: Red Cell Distribution Width (RDW), a routinely measured and cost-effective hematologic parameter, may serve as a viable prognostic marker. Sepsis is a major cause of mortality. Prognostic scores like SOFA and APACHE II are complex and resource-intensive. **Aims and Objective**: To evaluate the prognostic value of RDW and compare it with the APACHE II score in patients having sepsis. **Material and Methods**: Study was a hospital based prospective observational study conducted from October 2025 to March 2026. Seventy four Patients admitted with sepsis who presented to the inpatient department (IPD), High Dependency Unit (HDU), and Intensive Care Unit (ICU) of Madhubani Medical College and Hospital, Madhubani, Bihar, India who met the inclusion criteria were studied. **Results:** The mean age of patients is 41.65 ± 16.9 years. The majority of cases fall within the 41-50 years age group (32.4%), followed by 31-40 years (24.3%) and 51-60 by 17.5% respectively. Majority of Patients in Higher RDW Categories: Most patients (84.7%) have RDW values greater than 16%, with the largest group being those with RDW > 19% (46.8% of patients). Elevated RDW values (>19%) may indicate underlying inflammation, nutritional deficiencies (e.g., iron, B12), or chronic disease. **Conclusion:** This study highlights key clinical and demographic factors that influence sepsis outcomes. Advanced age, hypotension, tachycardia, elevated PCT, creatinine, and inflammatory markers were associated with higher mortality.

Keywords: *Hemoglobin, Prognosis, Red cell distribution width and Sepsis.*

INTRODUCTION

Red cell distribution width (RDW) is a convenient and inexpensive measurement of the variation in the size of the erythrocyte and an index of its heterogeneity commonly used in combination with different laboratory tests for the differential diagnosis of hematological system diseases, iron deficiency anemia, and bone marrow dysfunction [1]. The detection of an RDW value below the standard reference value is infrequent and clinically meaningless, whereas values above the normal range mirror the presence of anisocytosis, probably attributable to the presence of small and large red blood cells (RBCs), or both [2]. Recent evidence suggests that RDW values are commonplace in patients with various disorders, especially in those with the most prevalent conditions such as diabetes, cardiovascular diseases (CVDs), infection, and cancer [3]. The value of RDW is now being regarded as a strong and independent risk factor for mortality in the general population [4]. Although it has not been definitely shown whether an increased level of RDW is a risk factor or an epiphenomenon of an underlying biological and metabolic imbalance as an innocent bystander, it seems reasonable to suggest that the assessment of this parameter should be broadened far beyond the differential diagnosis of anemia and should now be regarded as a "non"-innocent bystander [3, 4]. This review provides some general information about RDW, its routine assessment, and potential clinical application. Sepsis is a life-threatening clinical condition that has cost humanity heavily since time immemorial. This clinical syndrome has been found to have increasing incidence throughout the world in recent decades [5,6] Initially, sepsis was defined as systemic inflammatory response to infection, noting that multiple noninfectious causes could elicit the similar response.[5,6,7] In 2001, a second consensus panel expanded the list

of variables for defining sepsis including organ dysfunction parameters as well [8]. Severity of illness and mortality risk escalates with severity of organ dysfunction. Severe sepsis and septic shock carry high potential mortality rates, possibly up to 40%–50% [6]. Prognostication in severe sepsis may facilitate aggressive management of particular patient groups. Prognostic factors such as age, sex, comorbidities, biomarkers (C-reactive protein [CRP], procalcitonin, etc.,), and severity of illness score (Acute Physiology and Chronic Health Evaluation [APACHE], etc.,) have been reported to be associated with the outcome in cases of severe sepsis [9,10,11].

Red cell distribution width (RDW) represents the variation in size of all the red blood cells (RBCs) in an individual patient. It is elevated when excess of reticulocytes are released into the circulation. Over and above its role in the evaluation of anemia, RDW has been found to be an important prognostic marker in the patients with cardiovascular disorders, pulmonary embolism, community-acquired pneumonia, and critical illness [12,13,14,15]. The association was independent of covariates such as nutritional status, anemia, other inflammatory markers, and comorbidities. Inflammation and oxidative stress have been suggested to reduce RBC survival and suppress their maturation resulting in release of large premature RBCs into circulation, contributing to elevated RDW [15,1,6,17]. Inflammation and oxidative stress are the essential components of sepsis cascade [6]. Complete blood count (CBC) is nowadays done in most of the sepsis patients admitted to the emergency medical services by automated analyzers all over the world. RDW is routinely provided within the CBC done by automated analyzers. Inexpensive, routinely available, and rapidly measurable prognostic tools have clinical utility in the identification of subset of patients with severe sepsis who need aggressive management. RDW could be a useful tool in prognostication of cases with severe sepsis as described in recent studies [18,1,9,20].

AIMS AND OBJECTIVE To evaluate the prognostic value of RDW and compare it with the APACHE II score in patients having sepsis

MATERIAL AND METHODS

Study was a hospital based prospective observational study conducted from October 2025 to March 2026. Seventy four Patients admitted with sepsis who presented to the inpatient department (IPD), High Dependency Unit (HDU), and Intensive Care Unit (ICU) of Madhubani Medical College and Hospital, Madhubani, Bihar, India who met the inclusion criteria were studied.

INCLUSION CRITERIA:

Patients admitted to Intensive Care Units who met the criteria of sepsis and septic shock According to International Guidelines for Management of Sepsis

EXCLUSION CRITERIA:

Patients with previous history of diseases primarily affecting RBCs, blood loss >10% of blood volume, blood product transfusion one week prior to admission, use of drugs known to change morphology and rheology of RBCs and pregnant patients were excluded from the study.

STATISTICAL ANALYSIS

Data was entered in MS excel and analyzed using SPSS version 17. Descriptive studies of mortality and complications were analyzed and presented in terms of Percentages. Chi-Square Test was used to compare the proportion of death and complications between the groups

RESULTS

Table 1 Age Distribution of Patients (n=74)

SN	Age Group	No	%
1	<20 Years	2	2.7%
2	21-30 Years	6	8.1%
3	31-40 Years	18	24.3%
4	41-50 Years	24	32.4%
5	51-60 Years	13	17.5%
6	61-70 Years	5	6.7%
7	70+ Years	6	8.1%
	Total	74	100

The mean age of patients is 41.65 ± 16.9 years. The majority of cases fall within the 41-50 years age group (32.4%), followed by 31-40 years (24.3%) and 51-60 by 17.5% respectively.

Table 2: Distribution of Patients by RDW Values

RDW Range (%)	Number of Patients (n)	Percentage (%)
<14	11	14.86%
14-16	29	39.18%
>16	34	45.94%

Majority of Patients in Higher RDW Categories: Most patients (84.7%) have RDW values greater than 16%, with the largest group being those with RDW > 19% (46.8% of patients). Elevated RDW values (>19%) may indicate underlying inflammation, nutritional deficiencies (e.g., iron, B12), or chronic disease

DISCUSSION

RDW is a measure of degree of RBC size variability. It is calculated as the SD in RBC size divided by the MCV. RDW values are determined by many factors. Elevation in RDW has been shown to be associated primarily with conditions that lead to ineffective production or increased destruction of RBC. Sepsis syndrome influences erythropoiesis through various mechanisms. Elevated inflammatory markers (tumor necrosis factor α, interleukin 6, interleukin 1β, etc.) affect the RBC survival and maturation. Early release of immature, larger RBCs into the circulation results in elevated RDW. Pro-inflammatory state in sepsis syndrome also leads to decreased erythropoietin production, resistance to its effect, as well as decreased iron bioavailability. Erythroid precursor activity is thus suppressed in the bone marrow [20,21, 22, 23] Oxidative stress may also be a contributor for RDW-mortality association in sepsis. Elevated RDW is seen in states of high oxidative stress. It occurs by decreased RBC survival and release of large premature RBCs into circulation [24]. Raised RDW group had significantly higher percentage of patients with anemia and renal dysfunction. There are many studies examining the association of high RDW values with in/out-of-hospital mortality in different populations, concluding that a high value of RDW is a strong and independent predictor of mortality. Researchers suggested that the use of this parameter as an inexpensive prognostic marker in addition to other scores such as APACHE improves the prognostication of patients, especially critically ill ones {7,57,-59/ 25, 26-28].

CONCLUSION

This study highlights key clinical and demographic factors that influence sepsis outcomes. Advanced age, hypotension, tachycardia, elevated PCT, creatinine, and inflammatory markers were associated with higher mortality. The APACHE 2 score and RDW emerged as critical predictors of sepsis prognosis, with higher values significantly correlating with poor outcomes. Early identification of these risk factors, coupled with timely and aggressive management, is essential to improving survival rates in sepsis patients. Further research should focus on targeted interventions and refining prognostic models to enhance the clinical management of sepsis.

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