SSRG International Journal of Medical Science
ISSN: 2393 – 9117 / https://doi.org/10.14445/23939117/IJMS-V9I2P102

Volume 9 Issue 2, 8-11, Mar-Apr 2022

Original Article

RDW at Admission as a Prognostic Factor in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

Wael Obaidtaha[1], Malek Hejazie[2], Firas Hussein[3]

[1,2]*Department of pulmonary disease, Tishreen University, Faculty of medicine, Lattakia, Syria.*
[3]*Department of Hematology, Tishreen University, Faculty of medicine, Lattakia, Syria.*

Received Date: 01 February 2022
Revised Date: 09 March 2022
Accepted Date: 20 March 2022

Abstract *- This study aims to determine the predictive value of RDW in a patient with acute exacerbation of COPD and determine the other factor related to mortality during hospitalization. A prospective cohort study was conducted on 112 patients. They are selected from the Department of pulmonary disease, Tishreen University Hospital in Lattakia-Syria, between January 2020 and January 2021. Blood samples were taken, and a complete blood count CBC was performed to know the RDW value at admission. Results Of the 112 patients enrolled in the study,70(62.5%) had a high RDW value above (14.6%). A higher RDW value at admission was associated with a higher rate of mortality (P=0,0001), the need for NIMV(P= 0.02), the failure of NIMV(P=0.01), and a higher RDW value was associated with increased length of hospital stay(P= 0.04). The statistical variables were inserted into the logistic regression equation to identify the independent indicators for the warning of death within the hospital. We found that the high level of RDW is a prognostic biomarker of death in hospitals (OR=3.9, P=0,0001). In addition to that, the presence of heart failure in the medical history of the patients (OR=2.2, P=0.001), higher Pco2 value(OR=3.2, P=0.005), and PH< 7,30 (OR=2.7, P=0.001).*

Keywords *- RDW, COPD, Acute Exacerbation, Prognosis.*

I. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) ranked as the third most common cause of death worldwide after ischemic heart disease and stroke in 2010[1]. Clinically, acute exacerbations of COPD (AECOPD) are the most important events in the history of this disease, and it's in 1hospital mortality is reported at 2.5%[12], 7.25%[13],7.4%[14], and 10% [15]. Red blood cell distribution width (RDW) measures red blood cell size heterogeneity and reflects the erythrocyte morphology[10]. It is a component of complete blood count, and it is used in the differential diagnosis of anemia [11]. Several recent studies have shown the association of the RDW with increased mortality in patients with CHF,[2,3] CHD[4,5], and atrial fibrillation[6,7]. The RDW is also a prognostic factor for infectious diseases [8,9]. Tertemiz et al. reported that the RDW could predict COPD severity [10]. In respiratory medicine area, the relation of higher RDW with mortality have been shown for lung cancer[17,16], pulmonary hypertension[20], pulmonary embolism[19,18], acute dyspnea[22], community-acquired pneumonia[21] and stable COPD patients[23].

The state of oxidative stress and inflammatory cytokines circulating during chronic diseases cause metabolic and structural damage to erythrocytes that affect their age and maturity and lead to an increase in their adhesion to the endothelium of the vessels and a weakening of their ability to change their shape [24], which leads to increased blood viscosity and reduced blood flow in the capillary circulation and thus reduces the delivery of oxygen to the tissues and worsens the prognosis [25] and among the metabolic and structural damages is also the lack of its content of hemoglobin [24] as the lack of elasticity of the cell membrane of the globule exposes it to a breakdown in the capillary circulation and the release of free hemoglobin, which in turn carries a danger Formation of ROS because it contains heme [26]. The oxidative stress condition causes an increase in erythrocyte affinity for oxygen [27] and reduces the effectiveness of antioxidants [28]. Therefore, RDW is considered an important biomarker for erythrocyte damage, as its height reflects a difference in erythrocyte volumes more than normal, which in turn indicates a defect in the process of erythrocyte formation and its short life, in addition to the excessive release of reticular cells to peripheral circulation [29].

Hence the importance of RDW with the association of its height with damage to erythrocytes and thus as an important vital indicator of its dysfunction in delivering oxygen to tissues, which may explain its alarming role in many chronic diseases and acute events that occur in its context, including the acute attack of chronic obstructive pulmonary disease.

II. PATIENTS AND METHODS

This is a Prospective cohort study of patients with acute exacerbation of copd attending the Department of pulmonary disease at Tishreen University Hospital in Lattakia-Syria for one year (January 2020- January 2021). The inclusion criteria were: All patients with AECOPD who met Gold's admission criteria. The exclusion criteria were:1 -anemia as per WHO definition (Hg<12 for women, Hg<13 for men),2 –CRF, 3 –Malignancies, 4 -history of blood transfusion in the last three months. Complete medical history together with a physical examination was done. A complete blood count(CBC) was performed on admission for all patients. The patients were sorted into two groups: 70 patients with a normal RDW value during admission(RDW≤14,6) and 42 patients with an elevated RDW value (RDW>14,6) following patient clinical development during hospitalization. COPD severity was graded based on the Global Initiative of Obstructive Pulmonary Disease classification, using lung function and clinical assessment.

A. Ethical Consideration

All patients were provided with complete and clear informed consent after discussing the study. This study was performed following the Declaration of

B. Statistical Analysis

Statistical analysis was performed by using IBM SPSS version 20. Basic Descriptive statistics included means, standard deviations(SD), Frequency, and percentages. Differences among different groups were examined using the chi-square or Fisher exact test. The statistical variables were inserted into the logistic regression equation to identify the independent indicators for the warning of death within the hospital.

III. RESULTS

The study included a group of 112 patients who fulfilled the study's criteria, out of whom 29(25.9%) were women. Age ranged from 37 to 87 years, with the mean age being 67.4±10.9 years. Of the 112 patients, 100(89.3%) were a smoker or former smokers, and 12(10.7%) were non-smokers, 83.9% were with advanced COPD (groups C and D). The most common comorbid were HTN (n:57), Chronic heart failure (n:37), and DM II (n:34). RDW was high in 42 cases (37.5%), represented in figure (1).

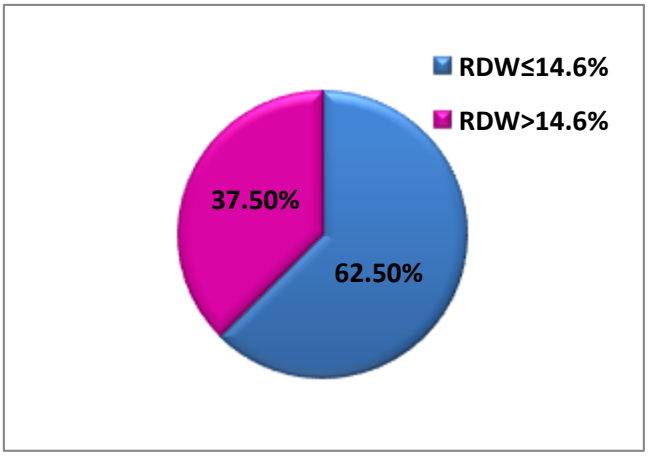

Fig. 1 Distribution of the study sample according to the RDW value

Patients were classified as high RDW group and normal RDW group. When patients with increased RDW levels compared to normal ones: no statistically significant difference was found concerning gender, age, and presence of HTN and DM II. However, it was found that the presence of exitus, need for NIMV, failure of NIMV, and CHF as comorbidity were significantly higher in patients with increased RDW levels with respect (P=0.0001) (P=0.02) (P=0.01) (P=0.03). The comparison of exacerbation characteristics according to RDW levels was shown in Table-1 and Table-2.

Table 1. Distribution of demographic characteristics according to RDW value

Complications In Hospital	RDW>14.6	RDW≤14.6	P-value
Death	7(16.7%)	0(0%)	0.0001
Need of NIMV			
Success	24(57.1%)	25(35.7%)	0.02
Failure	5(11.9%)	3(4.3%)	0.01
Need of ICU	8(19%)	9(12.9%)	0.06

Table 2. Distribution of complications according to RDW value

demographic characteristic	RDW>14.6	RDW≤14.6	P-value
Sex			
Male	31(73.8%)	57(81.4%)	0.1
Female	11(26.2%)	13(18.6%)	
Age(Year)	70±7.5	65.9±12.4	0.06
Comorbidity			
DM II	11(26.2%)	23(32.9%)	0.4
HTN	23(54.8%)	34(48.6%)	0.5
CHF	18(42.9%)	19(27.1%)	0.03

The statistical variables were inserted into the logistic regression equation to identify the independent indicators for the warning of death within the hospital. As shown in Table-

3, We found that the high level of RDW is a prognostic biomarker of death in hospitals (OR=3.9, 95%CI [1.4 – 8.8], P=0,0001). In addition to that the presence of heart failure in the medical history of the patients (OR=2.2, 95%CI[0.9 – 6.5], P=0.001), higher Pco2 value (OR=3.2,95%CI[1.7 – 9.2], P=0.005) and PH< 7,30 (OR=2.7, 95%CI[1.9 – 3.9], P=0.001). As it is clear in Figure 2 that there was a linear correlation between RDW values and Pco2 values of the study sample.

Table 3. Independent risk factors for death during hospitalization

Risk Factors	OR a	Confidence interval(95%)	P-value
Pco2	3.2	[1.7_9.2]	0.005
RDW	3.9	[1.4_8.8]	0.0001
CHF	2.2	[0.9_6.5]	0.001
PH<7.30	2.7	[1.9_3.9]	0.001

As it is clear in Figure 2 that there was a linear correlation between RDW values and Pco2 values of the study sample(r=0.3, P=0.01).

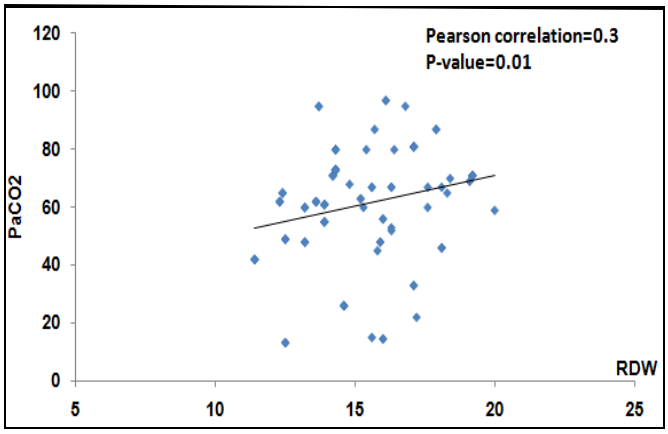

Fig. 2 Correlation between Pco2 and RDW values

IV. DISCUSSION

This study demonstrated that nearly one-third of the hospitalized COPD patients with exacerbation had increased RDW levels. There were no statistically significant differences in gender, smoking history, and need for ICU in patients with increased RDW levels compared to normal ones.

However, it was found that the presence of exitus and the need for NIMV were significantly higher in patients with increased RDW levels.

The red blood cell distribution width (RDW) is a simple and cheap parameter that is a component of the hemogram. It reflects the degree of heterogeneity of erythrocyte volume. It is also known as anisocytosis. RDW is used for differential diagnosis of anemias [11]. Besides this, RDW is a recently recognized biomarker of adverse outcomes in various acute and chronic conditions [19]. An increased RDW is related to impaired erythropoiesis and abnormal red blood cell survival, which may be attributed to various underlying metabolic abnormalities such as oxidative stress, inflammation, erythrocyte fragmentation, and alteration of erythropoietin function [11].

The main finding was that an increased RDW was a strong independent prognostic factor for hospital mortality. The literature on the RDW for AECOPD prognosis is sparse.

A retrospective study by Tertemiz et al. in patients with stable COPD found that the RDW increased with an increase in the BODE (body mass index, airflow obstruction, dyspnoea, and exercise) index and that the survival rate was 31% in patients with an RDW .14.3% and 75% in patients with an RDW,14.3%[10].

Seyhan et al. reported that an increased RDW was associated with increased mortality risk in patients with stable COPD [23].

Song et al. found that an RDW of .13.6% measured on the day of hospital discharge was significantly correlated with 6-month mortality for AECOPD patients [30].

We found that the risk factors for AECOPD mortality were high RDW, CHF, high Pco2, and pH>7.30. These findings were consistent with previous studies.

The association between an increased RDW and mortality in AECOPD is incompletely understood. However, we can proffer two explanations. The first may be hypoxemia. Hong et al. reported that the RDW measured at the emergency department is an independent and additional predictor of early mortality in patients with acute dyspnoea [21]. Second, our study found that CHF is a risk factor for death in patients with AECOPD. Several studies have reported that an increased RDW is associated with CHF [31] and with mortality in CHF.[2,3,4] .Sincere et al. reported that the RDW could be used to identify COPD patients with right ventricular failure[32].

In summary, we emphasize the importance of monitoring the RDW level at admission, especially with prior history of CHF, and taking protective measurements for these patients.

V. CONCLUSION

We demonstrated that elevated RDW predicts an increased risk of in-hospital death in AECOPD. Because testing for RDW values in AECOPD patients is an affordable method that will not require any additional costs either for the patient or the hospital, the potential prognostic value of RDW should be integrated into the comprehensive management of patients with ACOPD.

REFERENCES

[1] Lozano R, Naghavi M, Foreman K, et al., Global and Regional Mortality from 235 Causes of Death for 20 Age Groups in 1990 and 2010: A Systematic Analysis for the Global Burden of Disease Study. 380 (2012) 2095-128.

[2] Bonaque JC, Pascual-Figal DA, Manzano-Fernandez S, et al., Red Blood Cell Distribution Width Adds Prognostic Value for Outpatients with Chronic Heart Failure, Rev ESP Cardiol (Engl Ed). 65(7) (2012) 606–612.

[3] Huang YL, Hu ZD, Liu SJ, et al., Prognostic Value of Red Blood Cell Distribution Width for Patients with Heart Failure: A Systematic Review and Meta-Analysis of Cohort Studies, PLOS ONE. 9(8) (2014) e104861.

[4] Akboga MK, Yayla C, Yilmaz S, et al., Increased Red Cell Distribution Width Predicts Occlusion of the Infarct-Related Artery in STEMI, Scand Cardiovasc J. 50(2) (2016) 114–118.

[5] Loprinzi PD, Comparative Evaluation of Red Blood Cell Distribution Width and High Sensitivity C-Reactive Protein in Predicting All-Cause Mortality and Coronary Heart Disease Mortality, Int J Cardiol. 223 (2016) 72–73.

[6] Wan H, Yang Y, Zhu J, et al., The Relationship Between Elevated Red Cell Distribution Width and Long-Term Outcomes Among Patients with Atrial Fibrillation, Clin Biochem. 48(12) (2015) 762–767.

[7] Lee KH, Park HW, Cho JG, et al., Red Cell Distribution Width as a Novel Predictor for Clinical Outcomes in Patients with Paroxysmal Atrial Fibrillation, Europace. 17(2) (2015) ii83–ii88.

[8] Lee JH, Chung HJ, Kim K, et al., Red Cell Distribution Width as a Prognostic Marker in Patients with Community-Acquired Pneumonia, Am J Emerg Med. 31(1) (2013) 72–79.

[9] Topaz G, Kitay-Cohen Y, Peled L, et al., The Association Between Red Cell Distribution Width and Poor Outcomes in Hospitalized Patients with Influenza, J Crit Care. 41 (2017) 166–169.

[10] Tertemiz KC, Ozgen Alpaydin A, et al., Could Red Cell Distribution Width Predict COPD Severity? Rev Port Pneumol. 22(4) (2016) 196–201.

[11] Salvagno GL, Sanchis-Gomar F, Picanza A, Lippi G. Red Blood Cell Distribution Width: A Simple Parameter with Multiple Clinical Applications, Crit Rev Clin Lab Sci. 52(2) (2015) 86-105. Doi: 10.3109/10408363.2014.992064.

[12] Patil SP, Krishnan JA, Lechtzin N, Diette GB, In-Hospital Mortality Following Acute Exacerbations of Chronic Obstructive Pulmonary Disease, Arch Intern Med. 163 (2003) 1180-6.

[13] Fruchter O, Yigla M, Predictors of Long-Term Survival in Elderly Patients Hospitalized for Acute Exacerbations of Chronic Obstructive Pulmonary Disease, Respirology. 13 (2008) 851-5.

[14] Roche N, Zureik M, Soussan D, Neukirch F, Perrotin D, Predictors of Outcomes in COPD Exacerbation Cases Presenting to the Emergency Department, Eur Respir J. 32 (2008) 953-61.

[15] Gaude GS, Rajesh BP, Chaudhury A, Hattiholi J, Outcomes Associated with Chronic Obstructive Pulmonary Disorder Acute Exacerbations Requiring Hospitalization, Lung India. 32 (2015) 465-72.

[16] Warwick R, Mediratta N, Shackcloth M, Shaw M, McShane J, Poullis M, Preoperative Red Cell Distribution Width in Patients Undergoing Pulmonary Resections for Non-Small-Cell Lung Cancer, European Journal of Cardiothoracic Surgery: Official Journal of the European Association for Cardiothoracic Surgery. 45 (2014) 108-13.

[17] Koma Y, Onishi A, Matsuoka H, et al., Increased Red Blood Cell Distribution Width Associates with Cancer Stage and Prognosis in Patients with Lung Cancer, Plos One. 8 (2013) e80240.

[18] Hampole CV, Mehrotra AK, Thenappan T, Gomberg-Maitland M, Shah SJ, The Usefulness of Red Cell Distribution Width as a Prognostic Marker in Pulmonary Hypertension, The American Journal of Cardiology. 104 (2009) 868-72.

[19] Abul Y, Ozsu S, Korkmaz A, Bulbul Y, Orem A, Ozlu T, Red Cell Distribution Width: A New Predictor for Chronic Thromboembolic Pulmonary Hypertension After Pulmonary Embolism, Chronic Respiratory Disease. 11 (2014) 73-81.

[20] Zorlu A, Bektasoglu G, Guven FM, et al., Usefulness of Admission Red Cell Distribution Width as a Predictor of Early Mortality in Patients with Acute Pulmonary Embolism, The American Journal of Cardiology. 109 (2012) 128-34.

[21] Hong N, Oh J, Kang SM, et al., Red Blood Cell Distribution Width Predicts Early Mortality in Patients with Acute Dyspnea, Clinica Chimica Acta; International Journal of Clinical Chemistry. 413 (2012) 992-7.

[22] Braun E, Kheir J, Mashiach T, Naffaa M, Azzam ZS, Is Elevated Red Cell Distribution Width a Prognostic Predictor in Adult Patients with Community-Acquired Pneumonia? BMC Infectious Diseases. 14 (2014) 129.

[23] Seyhan EC, Ozgul MA, Tutar N, Omur I, Uysal A, Altin S, Red Blood Cell Distribution and Survival in Chronic Obstructive Pulmonary Disease Patients, Copd. 10 (2013) 416-24.

[24] M. R. Condon et al., Appearance of an Erythrocyte Population with Decreased Deformability and Hemoglobin Content Following Sepsis. 07103 (2021) 2177–2184.

[25] Y. Arbel et al., Red Blood Cell Distribution Width (RDW) and Long-Term Survival in Patients with ST Elevation Myocardial Infarction, Thromb. Res. 134(5) (2014) 976–979.

[26] V. Jeney, G. Balla, and J. Balla, Red Blood Cell, Hemoglobin and Heme in the Progression of Atherosclerosis, Front. Physiol. 5 (2014) 379.

[27] E. el din S. Ibrahim, S. A. McLellan, and T. S. Walsh, Red Blood Cell 2,3-Diphosphoglycerate Concentration and in Vivo P50 During Early Critical Illness*, Crit. Care Med. 33(10) (2005).

[28] S. C. Rogers, A. Said, D. Corcuera, D. Mclaughlin, P. Kell, and A. Doctor, Hypoxia Limits Antioxidant Capacity in Red Blood Cells by Altering Glycolytic Pathway Dominance. 3159–3170. Doi: 10.1096/fj.09-130666.

[29] A. S. Said, P. C. Spinella, and M. E. Hartman, Red Blood Cell Distribution Width: Biomarker for Red Cell Dysfunction and Critical Illness Outcome?. 18(2) (2018) 134–142. Doi: 10.1097/PCC.0000000000001017.Red.

[30] Song Yu YY-h, Wang C, Predictive Value of Red Cell Distribution Width on the Short-Term Prognosis of Chronic Obstructive Pulmonary Disease, Chinese J Pract Intern Med. 35(3) (2015) 239–241.

[31] Yang HJ, Liu X, Qu C, Shi SB, Liang JJ, Yang B, Usefulness of Red Blood Cell Distribution Width to Predict Heart Failure Hospitalization in Patients with Hypertrophic Cardiomyopathy, Int Heart J. 59(4) (2018) 779–785.

[32] Since I, Zorlu A, Yilmaz MB, et al., Relationship Between Red Cell Distribution Width and Right Ventricular Dysfunction in Patients with Chronic Obstructive Pulmonary Disease, Heart Lung. 41(3) (2012) 238–243.