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Research Article

RED CELL DISTRIBUTION WIDTH VALUE AS A PREDICTOR OF COPD SEVERITY: ORIGINAL RESEARCH ARTICLE

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ABSTRACT

Objectives: The purpose of the study is to use the red cell distribution width (RDW) value for predicting chronic obstructive pulmonary disease (COPD) severity.

Methods: Three hundred COPD patients are included in this retrospective analysis. Oxygen saturation, BODE index variables, and demographic characteristics were noted. All patients' survival data were analyzed. RDW measurements were evaluated at the time of inclusion.

Results: The patients had an average age of 65.2±8.6 years. The patients were divided into the following stages of COPD: stage 1: 14.66%, stage 2: 56.66%, stage 3: 25.6%, and stage 4: 3%. Red cell distribution width was observed differ significantly between stages. The very high RDW was found in the extremely serious stage ($p<0.001$). The BODE index has a median of 1 (0–3). RDW increased with the BODE index as it increased ($p<0.001$). The survival percentages for the groups of patients created based on the laboratory upper limit of RDW was 76% for groups with RDW<14.3% and 29% for groups with RDW>14.3%.

Conclusion: Our study's findings suggest that an elevated level of RDW may be linked to increased mortality and that a quick, non-invasive test could be used as an early biomarker to assess the severity of a disease.

Keywords: Chronic obstructive pulmonary disease, Red cell distribution width, Hospitalization, Exacerbation.

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INTRODUCTION

Due to the disease's growing disability, people with chronic obstructive pulmonary disease (COPD) have a dismal prognosis. It is possible to prevent and cure COPD, which is characterized by a continual airflow limitation that often gets worse over time and is related with an exaggerated chronic inflammatory, response in the lungs and airways to noxious particles or gases. It continues to be the fifth-leading cause of death worldwide, and by 2030, it is expected to rank third [1]. At present, heart disease instead of respiratory failure is the main cause of death, and COPD is recognized as a component of the systemic inflammatory syndrome [2].

Red cell distribution width (RDW) is a typical laboratory measurement and it determines the size variability of circulating RBC. The main utility of red cell distribution width is in determining the possibility of microcytic anemia. A chronic underlying inflammation that promotes alterations in erythropoiesis and red blood cell membrane deformability has been associated to elevated RDW levels [3].

METHODS

Study was done at the Department of Respiratory Medicine of Sheth LG Hospital and AMC MET Medical College, Maninagar, Ahmedabad from June 2016 to Feb 2018 after obtaining consent of the participants. It was prospective observational Study.

Three hundred confirmed COPD cases were included in the study.

Exclusion criteria

Patients having any major systemic illness, malignancy, etc. were excluded from the study.

A 6-min walk test's (6MWT) findings, BODE index, pulmonary function test (PFT), and full blood counts were also documented in the patients' medical records at the time of enrollment (July 2004 and November 2005). The composite COPD evaluation index, which GOLD has advised using since 2011, is preferable.

Pulmonary function tests [4]

PFTs were carried out alone by one technician. The best test out of three successive tests was acceptable. The forced expiratory volume in one second, the forced vital capacity, and the ratio of the forced vital capacity to the forced expiratory volume in one second, or FEV_1/FVC, were all measured.

All participants had blood drawn to measure the RDW. In a three-part hematology cell counter, RDW is measured.

In our laboratory, the RDW normal range was between 11.5% and 13.8%.

Six-minute walk test [5] 35 m of a corridor was used for the 6MWT when the diagnosis was made. The goal was to get the patients moving as quickly as they could. Before and after the test, oxygen saturation was assessed, and the distance walked was noted.

BODE index [6] body mass index, force expiratory volume, 6 min walk test, and the modified Medical Research Council Dyspnea Scale were utilized for calculating the BODE index at the time of diagnosis.

Oxygen saturation

Pulse oxymetry is used to monitor oxygen saturation at the time of diagnosis.

Statistical analyses

Graph Pad Prism software was used to statistically analyze the entirety of the data that were collected.

To determine the significance of the difference, p-value for the student t-test was determined. A difference with a $p<0.05$ was deemed significant. After that, patients were classified based on the laboratory upper limit of RDW for a survival study. The initial day of the trial was the day; the patients were included in the study. On a survival analysis, the final day was taken as the date of the last examination or discharge. To further account for age, concomitant illnesses, FEV1, and 6MWT, Cox proportional hazards regression was used to do multivariate analysis for survival rates.

RESULTS

There are 300 COPD patients total in the study.

The study population's average age was 65.2±8.6 years.

The participants' demographic information is listed on Table 1.

Mean levels of RDW were observed raising with the severity of COPD (Table 2).

The 6 min walk test, lung functional parameters, and oxygen saturation all had an inverse relationship with RDW.

Table 3 observed that mild connection with age, GOLD stage, and a moderate link with the BODE index.

The study population's total 9-year survival rate was 59.5%. The 9-year survival rate for patients who were split into two groups based on RDW was 76% for those with a standard RDW (13.9%) and 29% for those with an raised RDW (>13.9%) (p=0.001) (Fig. 1). 6MWT and the age were found to be linked with living on multivariate analysis when relevant confounders were taken into account (Table 5).

Table 1: Demographic characteristics of the participants

Characteristic	n (%)
Gender	
Male	275 (91.66)
Female	25 (8.33)
Stages of GOLD	
Stage 1	44 (14.66)
Stage 2	170 (56.66)
Stage 3	77 (25.6)
Stage 4	09 (3.0)
Smoking status	
Past smoker	210 (70)
Doesn't smoke	50 (16.66)
Smoker	125 (41.66)
Comorbidity	
Yes	175 (59)
Cerebral small vessel disease	95 (54.28)
Diabetes mellitus	23 (13.14)
Others	57 (32.57)
No	125 (41.66)
Mortality cause	
Malignancy	30 (10)
Chronic obstructive pulmonary disease	28 (9.33)
Pneumonia	15 (5)
Cerebral small vessel disease	31 (10.33)
Kidney Damage	6 (2)
Neurogenic disease	3 (1)
BODE index (Median/min –max)	1.0 (0.0–10.0)

Table 2: RDW levels according to GOLD stages

	Average RDW (%)
GOLD stages	
Stage 1	13.7
Stage 2	13.8
Stage 3	14.5
Stage 4	15.6

Table 3: Relationship between RDW and functional and demographic factors

RDW correlation	r	p
Oxygen saturation	–0.261	0.247
BMI	–0.058	<0.01
Age	0.182	<0.01
BODE index	0.407	<0.01
GOLD stage	0.404	<0.01
%FEV1	–0.291	<0.01
%FVC	–0.285	<0.01
FEV1/FVC	–0.206	<0.01
%FEF 25–75	–0.303	<0.01
%PEF	–0.227	<0.01

DISCUSSION

The third most common cause of death worldwide is COPD, and it is affecting >174 million individuals [7]. In 2017, 3.2 million individuals died from COPD, and by 2040, that number is predicted to rise to 4.4 million annually [8]. Due to its high prevalence, as well as the associated impairment and mortality, COPD is a global public health challenge [9]. Acute exacerbations of COPD (AECOPD), especially those that result in hospitalization, are major cause of death, exacerbate the severity of a disease, and increase the financial burden of COPD [10]. Red cell distribution width which is included in routine complete blood count (CBC) reports is a measure that reflects the heterogeneity of red blood cell volume. Anemia, hematopoietic abnormalities, and congenital erythrocyte abnormality can all be diagnosed using an increase in red cell distribution width. Increased red cell distribution width has been linked to a number of disorders in earlier research, including congestive heart failure [11], congestive pulmonary hypertension (COPH) [12], COPD, and pulmonary hypertension [13]. Higher RDW has been shown to be a useful marker for estimating clinical outcomes in the context of COPD, including the severity of the disease [14], an independent predictor of mortality [15], readmission rate [16], right heart failure [17], pulmonary hypertension [18], higher BODE index [4], and other poor prognostic markers.

We found that increased RDW levels were related with the severity of COPD and that individuals with elevated RDW levels also had higher mortality rates. In contrast, a second study found that the RDW levels associated with smokers were higher than those associated with non-smokers [4]. Researchers find that patients having decreased FEV_1 and lower diffusing capacity had high RDW in a different study that indicates the prognostic utility of RDW in people with idiopathic pulmonary fibrosis. They concluded that RDW provided a distinct source of predictive information both at initial stage of COPD and throughout follow-up. The results of our investigation also revealed a negative association between RDW and the results of the PFT. This result was consistent with the Increased RDW levels we found in the extremely severe group of people with severe COPD. In addition, we found a correlation between frequency of smoking and RDW levels, which may be caused by erythropoiesis associated to hypoxemia. This theory is also supported by the relationship between RDW levels and oxygen saturation. In our investigation, the BODE index, which has been linked to COPD mortality, was related to RDW.

An association between RDW and C reactive protein, right ventricular dysfunction, and pulmonary arterial hypertension was seen in a recent study exploring the predictive usefulness of RDW in COPD [19]. We also discovered increased RDW levels in patients of severe COPD,

Table 4: Particip ants' functional and demographic characteristics according to the maximum RDW value

	All patients	RDW <14.3	RDW >14.3	p
Age	65.2	65.4	67.9	
FEV1(L)	1.67	1.80	1.34	<0.01
%FEV1	60.1	64.5	50.3	<0.01
FVC (L)	2.96	3.02	2.44	<0.01
%FVC	80.8	85.1	71.2	<0.01
FEV1/FVC	57.2	58.7	53.9	<0.01
PEF (L)	4.79	5.1	4.1	<0.01
%FEF 25/75	26.1	28.7	20.3	<0.01
Smoking (packyear)	59	52.5	63.3	>0.01
Smoking beginnersage	17.7	18.4	16.	>0.01
BMI	25.4	25.6	24.9	<0.01
6MWT (mt)	435	453	393	<0.01
O_2%	96	96.4	95.1	<0.01
BODE index	1.83	1.32	2.98	<0.01

Table 5: RDW's effect on survival and potential confounders

	Odds ratio	95%confidence limit	p-value
6MWT	0.998	0.997–1.000	>0.01
Age	1.056	1.033–1.077	<0.01
Comorbidities	1.520	1.004–2.036	<0.01
FEV1	0.525	0.375–0.747	<0.01
RDW	1.123	1.153–1.295	<0.01

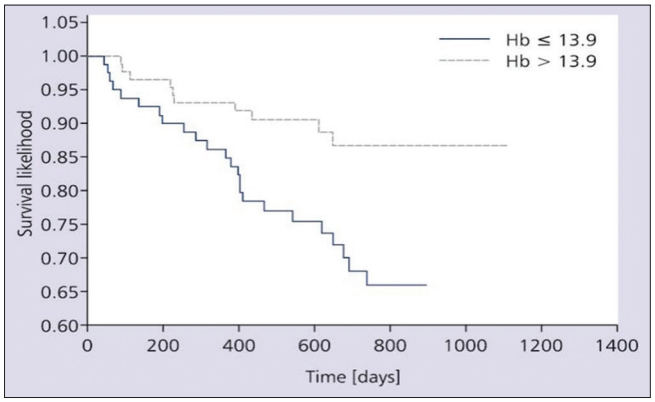

Fig. 1: Likelihood of survival rate

which leads us to suspect that RDW may serve as a prognostic systemic inflammatory marker in COPD. Independent correlation between RDW and survival has been proven for a variety of pulmonary disorders, and cardiovascular including pulmonary hypertension, idiopathic pulmonary fibrosis, acute pulmonary embolism, and even COPD [20].

CONCLUSION

Our study's findings suggest that an elevated level of RDW may be linked to increased mortality and that a quick, non-invasive test could be used as an early biomarker to determine the severity of a disease.

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CONFLICTS OF INTEREST

None.

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