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ORIGINAL ARTICLE

Elevated Red Cell Distribution Width Predicts the Adverse Outcome of Patients Hospitalized with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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Abstract:

Background: *Chronic obstructive pulmonary disease (COPD) is one of the leading causes of morbidity and mortality in the world. Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) causes repeated hospitalization of patients. The readmission risk of these patients should be assessed by any means specially any laboratory test that would show consistent association. Red Blood Cell Distribution Width (RDW) is an automatically calculated measure of routine hemogram test which is very simple and inexpensive. Increased RDW is associated with prognosis of many medical conditions, but still not well evaluated for the prognosis of AECOPD.*

Objectives: *To evaluate the RDW level for prediction of prognosis in patients hospitalized with AECOPD.*

Methods: *A population-based observational cohort study conducted on patients who were hospitalized due to AECOPD in Shaheed Tajuddin Ahmad Medical College Hospital, Gazipur from January 2017 to December 2018. Clinical and laboratory test reports of all participants were recorded. They were observed to measure the incidence of readmission due to AECOPD, readmission from any other cause and composite end point of readmission or death during 60 days after discharge from hospital.*

Results: *Total 146 patients were included in the study. Overall readmission rate of patients within 60 days of index hospitalization was 28.21%, among them 48.63% readmitted patients were due to AECOPD. Composite end point (readmission or death) were found significant ($p<0.05$) in patients with congestive heart failure, acidosis before discharge and high RDW at admission.*

Conclusion: *High RDW levels in patients with AECOPD admitted in hospital are usually associated with an increased risk for early readmission as well as increased mortality.*

Key words: *Red cell distribution, Chronic obstructive pulmonary disease*

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Introduction:

Chronic obstructive pulmonary disease (COPD) is a chronic inflammation of the respiratory tract and lungs that progressively causes damage to lung tissue and reduces the airflow. The Global Burden of Disease Study estimated that COPD will be the

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third leading cause of death in the world by 2030.[1] Acute exacerbation is a key event of natural history of COPD and Acute exacerbation of Chronic obstructive pulmonary disease (AECOPD) is one of the most common causes of hospitalization worldwide. Many of those patients require readmission in hospital within 60 days of discharge after prior hospitalization for AECOPD.

Red Blood Cell Distribution Width (RDW) is a laboratory parameter that can be evaluated for differential diagnosis of microcytic anemia. Recently, elevated RDW emerged as a negative prognostic factor in variety of medical conditions.[2]

COPD also has a systemic inflammatory effect. The inflammatory process may extend beyond the pulmonary system, resulting in a state of persistent low-grade systemic inflammation which has been implicated in various complications of COPD including cachexia, CVD, and arrhythmias. [3-5] Inflammation has been proposed as a key element in the association of COPD and CVD. It can be concluded that RDW levels, which is considered to be a marker of inflammation, may be elevated in patients with COPD as well as in CVD. Two recent studies have reported that high RDW levels in patients with COPD correlated with right ventricular dysfunction and overall survival. [6]

The RDW level was assessed in patients with stable COPD which showed the association of elevated RDW with severity of stable COPD and risk of mortality. [6-7] But, the RDW level has not been so far evaluated for prediction of prognosis in patients hospitalized with AECOPD. Hence we designed this study to explore whether RDW is useful for prediction of adverse outcomes of patients hospitalized with AECOPD.

Methodology:

We conducted a population-based observational cohort study, using the data of patients who were hospitalized due to AECOPD in Shaheed Tajuddin Ahmad Medical College Hospital, Gazipur from January 2017 to December 2018. The study population included patients 40 years or older with a primary diagnosis of AECOPD. Our study did not include patients who died during an index hospitalization, patients who were discharged on request or with risk bond, and patients transferred to another hospital. All participants were observed to measure the incidence of readmission due to AECOPD, readmission from any other cause and composite end point of readmission or death during 60 days after discharge from hospital. Data like demographics, vital signs at admission, comorbidities and laboratory values were retrieved from the medical records of the patients. Qualitative variables were expressed as numbers and percentage while quantitative variables were expressed as means and standard deviations. Normal distribution of variables was determined by using the Kolmogorov–Smirnov test before comparison of means. An independent samples Student's t test was used to compare normally distributed means. Differences between dichotomous variables were analyzed by the Chi-squared test.

Results:

During the study period total 180 patients were admitted in hospital with primary diagnosis of AECOPD. 11 patients died during hospital stay (6.11%), 4 patients were transferred to other hospital (2.2%) and 19 patients had no available data regarding RDW values (10.56%). Finally 146 patients were included in the study. Overall readmission rate of patients within 60 days of index hospitalization was 28.21%, among them 48.63% readmitted patients were due to AECOPD.

Mean Charlson comorbidity index was found 4.6±2.9 in 60 days readmission and 6.6±36 in 60 days without readmission due to AECOPD. The mean RDW at admission was found 15.9±2.4 in 60 days readmission and 14.7±1.8 in 60 days without readmission due to AECOPD. Majority (85.7%) patients were found hypercapnic at admission in 60 days readmission and 65(49.2%) in 60 days without readmission due to AECOPD. Majority (85.7%) patients were found hypercapnic before discharge in 60 days readmission and 56(42.4%) in 60 days without readmission due to AECOPD. Ten (71.4%) patients were found acidosis at admission in 60 days readmission and 39(29.5%) in 60 days without readmission due to AECOPD. Seven (50.0%) patients were found acidosis before discharge in 60 days readmission and 13(9.8%) in 60 days without readmission due to AECOPD. Which were statistically significant ($p<0.05$) between two group.

Table-I

Baseline characteristics of patients hospitalized for AECOPD and followed by readmission within 60 days due to AECOPD (n=146)

	Total	Readmission due to AECOPD		
	(n=146)	Yes(n=14)	No(=132)	P value
Mean age (years)	69.1±11.8	67.4±12.1	69.6±11.1	0.486
Male	88 (60.2%)	10 (71.4%)	78 (59.1%)	0.370
Current smoker	77 (53.0%)	9 (64.3%)	68 (51.5%)	0.363
Mean charlson comorbidity index	6.4±3.5	4.6±2.9	6.6±3.6	0.046
Hypertension	90 (61.5%)	9 (64.3%)	81 (61.4%)	0.830
Diabetes mellitus	49 (33.7%)	6 (42.9%)	43 (32.6%)	0.310
Congestive heart failure	31 (21.1%)	4 (28.6%)	27 (20.5%)	0.342
History of solid or hematologic malignancy	21 (14.3%)	2 (14.3%)	19 (14.4%)	0.675
Hypotension (MAP <65 mmHg) at admission	10 (7.0%)	2 (14.3%)	8 (6.1%)	0.246
Desaturation (SO_2 <90%) at admission	50 (34.6%)	7 (50.0%)	43 (32.6%)	0.156
Anemia* at admission	54 (36.7%)	5 (35.7%)	49 (37.1%)	0.917
Anemia before discharge	70 (48.0%)	8 (57.1%)	62 (47.0%)	0.469
Leukocytosis at admission (WBC >11 $\times 10^9$/L)	80 (54.8%)	10 (71.4%)	70 (53.0%)	0.188
Mean RDW at admission	15.0±1.9	15.9±2.4	14.7±1.8	0.023
Mean creatinine (mg/dL) at admission	1.16±0.88	1.02±0.38	1.17±0.91	0.543
Mean creatinine (mg/dL) before discharge	1.06±0.76	0.91±0.36	1.08±0.79	0.428
Hypercapnia (pCO_2 >45 mmHg) at admission	77 (52.6%)	12 (85.7%)	65 (49.2%)	0.009
Hypercapnia (pCO_2 >45 mmHg) before discharge	68 (46.3%)	12 (85.7%)	56 (42.4%)	0.002
Acidosis (pH <7.35) at admission	49 (33.5%)	10 (71.4%)	39 (29.5%)	0.003
Acidosis (pH <7.35) before discharge	20 (13.7%)	7 (50.0%)	13 (9.8%)	0.001
Mean length of hospital stay (days)	6.9±5.8	6.4±4.2	7.1±6.5	0.694

* (Hemoglobin <13g/dL male; <12g/dL female)

Table-II

Baseline characteristics of patients hospitalized for AECOPD and followed by readmission within 60 days due to any other causes (n=146)

	Total	Readmission from any other cause		
	(n=146)	Yes(n=37)	No(n=109)	P value
Mean age (years)	69.1±11.8	69.8±12.3	68.9±11.6	0.689
Male	88 (60.2%)	25 (67.6%)	63 (57.8%)	0.294
Current smoker	77 (53.0%)	21 (56.8%)	56 (51.4%)	0.571
Mean charlson comorbidity index	6.4±3.5	6.7±3.4	6.2±3.1	0.410
Hypertension	90 (61.5%)	26 (70.3%)	64 (58.7%)	0.212
Diabetes mellitus	49 (33.7%)	15 (40.5%)	34 (31.2%)	0.298
Congestive heart failure	31 (21.1%)	14 (37.8%)	17 (15.6%)	0.004
History of solid or hematologic malignancy	21 (14.3%)	5 (13.5%)	16 (14.7%)	0.861
Hypotension (MAP <65 mmHg) at admission	10 (7.0%)	4 (10.8%)	6 (5.5%)	0.226
Desaturation (SO_2 <90%) at admission	50 (34.6%)	15 (40.5%)	35 (32.1%)	0.315
Anemia* at admission	54 (36.7%)	15 (40.5%)	39 (35.8%)	0.604
Anemia before discharge	70 (48.0%)	18 (48.6%)	70 (47.7%)	0.921
Leukocytosis at admission (WBC >11 $\times 10^9$/L)	80 (54.8%)	21 (56.8%)	59 (54.1%)	0.781
Mean RDW at admission	15.0±1.9	15.6±2.0	14.8±1.8	0.031
Mean creatinine (mg/dL) at admission	1.16±0.88	1.22±0.82	1.13±0.88	0.585
Mean creatinine (mg/dL) before discharge	1.06±0.76	1.15±0.94	1.02±0.68	0.366
Hypercapnia (pCO_2 >45 mmHg) at admission	77 (52.6%)	24 (64.9%)	53 (48.6%)	0.087
Hypercapnia (pCO_2 >45 mmHg) before discharge	68 (46.3%)	23 (62.2%)	45 (41.3%)	0.028
Acidosis (pH <7.35) at admission	49 (33.5%)	16 (43.2%)	33 (30.3%)	0.149
Acidosis (pH <7.35) before discharge	20 (13.7%)	11 (29.7%)	9 (8.3%)	0.001
Mean length of hospital stay (days)	6.9±5.8	6.7±4.5	7.1±6.8	0.739

* (Hemoglobin <13g/dL male; <12g/dL female)

Table-III

Baseline characteristics of patients hospitalized for AECOPD and followed by 60 days composite end point (n=146)

	Total (n=146)	Composite end point (readmission or death)		
		Yes(n=44)	No(=102)	P value
Mean age (years)	69.1±11.8	69.7±12.2	69.0±11.4	0.739
Male	88 (60.2%)	27 (61.4%)	61 (59.8%)	0.860
Current smoker	77 (53.0%)	21 (47.7%)	56 (54.9%)	0.426
Mean charlson comorbidity index	6.4±3.5	7.1±3.7	5.9±3.0	0.041
Hypertension	90 (61.5%)	27 (61.4%)	63 (61.8%)	0.964
Diabetes mellitus	49 (33.7%)	14 (31.8%)	35 (34.3%)	0.770
Congestive heart failure	31 (21.1%)	15 (34.1%)	16 (15.7%)	0.013
History of solid or hematologic malignancy	21 (14.3%)	6 (13.6%)	15 (14.7%)	0.867
Hypotension (MAP <65 mmHg) at admission	10 (7.0%)	4 (9.1%)	6 (5.9%)	0.351
Desaturation (SO_2 <90%) at admission	50 (34.6%)	14 (31.8%)	36 (35.3%)	0.685
Anemia* at admission	54 (36.7%)	18 (40.9%)	36 (35.3%)	0.519
Anemia before discharge	70 (48.0%)	22 (50.0%)	48 (47.1%)	0.744
Leukocytosis at admission (WBC >11 $\times 10^9$/L)	80 (54.8%)	23 (52.3%)	57 (55.9%)	0.688
Mean RDW at admission	15.0±1.9	15.6±1.8	14.7±1.9	0.009
Mean creatinine (mg/dL) at admission	1.16±0.88	1.22±0.81	1.14±0.87	0.604
Mean creatinine (mg/dL) before discharge	1.06±0.76	1.14±0.94	1.03±0.68	0.428
Hypercapnia (pCO_2 >45 mmHg) at admission	77 (52.6%)	21 (47.7%)	56 (54.9%)	0.426
Hypercapnia (pCO_2 >45 mmHg) before discharge	68 (46.3%)	21 (47.7%)	47 (46.1%)	0.855
Acidosis (pH <7.35) at admission	49 (33.5%)	16 (36.4%)	33 (32.4%)	0.638
Acidosis (pH <7.35) before discharge	20 (13.7%)	12 (27.3%)	8 (7.8%)	0.002
Mean length of hospital stay (days)	6.9±5.8	7.1±5.4	6.9±7.1	0.863

* (Hemoglobin <13g/dL male; <12g/dL female)

Table-IV

Rate ratio[a] of patients with increased RDW values and different characteristics of patients and 60-day adverse events (n=146)

	Readmission due to AECOPD	Readmission from any cause	Composite end point (readmission or death)
Male	0.77	0.82	0.76
Current smoker	0.78	1.40	0.95
Hypertension	1.45	1.23	1.18
Diabetes mellitus	0.84	1.04	0.99
Congestive heart failure	1.55	3.07	2.14
History of solid or hematologic malignancy	0.46	0.41	0.87
Hypotension (MAP <65 mmHg) at admission	0.48	0.52	0.41
Desaturation (SO_2 <90%) at admission	1.05	1.80	1.58
Anemia before discharge	3.01	2.18	3.62
Leukocytosis at admission (WBC >11 $\times 10^9$/L)	1.06	1.11	0.80
Serum creatinine (>1.0 mg/dL) before discharge	0.51	1.99	1.09
Hypercapnia (pCO_2 >45 mmHg) before discharge	1.42	1.77	1.69
Acidosis (pH <7.35) before discharge	0.91	0.68	0.96

[a]Rate ratio for specific risk factor was calculated using the following equation:

Fourteen (37.8%) patients were found congestive heart failure in 60 days readmission and 17(15.6%) in without readmission. The mean RDW at admission was found 15.6±2.0 in 60 days readmission and 14.8±1.8 in without readmission. Twenty three (62.2%) patients were found hypercapnia before discharge in 60 days readmission and 45(41.3%) in without readmission. Eleven (29.7%) patients were found acidosis before discharge in 60 days readmission and 9(8.3%) in without readmission. Which were statistically significant ($p<0.05$) between two group.

Mean charlson comorbidity index were found 7.1±3.7 in 60 days composite end point and 5.9±3.0 in 60 days without composite end point. Fifteen (34.1%) patients were found congestive heart failure in 60 days composite end point and 16(15.7%) in 60 days without composite end point. Mean RDW at admission were found 15.6±1.8 in 60 days composite end point and 14.7±1.9 in 60 days without composite end point. Twelve (27.3%) patients were found acidosis before discharge in 60 days composite end point and 8(7.8%) in 60 days without composite end point. Which were statistically significant ($p<0.05$) between two group.

Rate ratios of patients with increased RDW values and different demographic factors, co-morbidities, vital signs at admission, laboratory test results and 60-day adverse events.

In multivariate analysis, charlson comorbidity index >5 and High RDW at admission were found to be significantly ($p<0.05$) associated with readmission due to AECOPD patients. Congestive heart failure, acidosis before discharge and High RDW at admission were found to be significantly ($p<0.05$) associated with readmission from any cause patients. Congestive heart failure, acidosis before discharge and High RDW at admission were found to be significantly ($p<0.05$) associated with Composite end point patients.

Table-V

Bivariate and multivariate analysis result of correlation between different characteristics of the patients and 60-day adverse events

	Readmission due to AECOPD		Readmission from any cause		Composite end point (readmission or death)	
	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Univariate analysis						
Mean age (years)	0.96 (0.52-1.14	0.069	1.13 (0.83-1.22)	0.189	1.45 (0.76-1.78)	0.441
Male	1.23 (0.42-14.83)	0.875	1.26 (0.53-1.59)	0.943	1.16 (0.80-1.69)	0.342
Current smoker	3.26 (0.51-13.71)	0.212	1.14 (0.47-1.44)	0.631	1.30 (0.88-1.76)	0.156
Charlson comorbidity index >5	0.16 (0.27-0.94)	0.041	1.03 (0.91-2.09)	0.745	1.44 (1.12-2.31)	0.044
Hypertension	2.7 (0.17-9.71)	0.487	2.84 (0.95-3.40)	0.177	1.41 (0.76-2.23)	0.313
Diabetes mellitus	0.89 (0.42-1.81)	0.763	1.20 (0.71-1.74)	0.241	1.19 (0.74-1.87)	0.247
Congestive heart failure	1.04 (0.13-8.03)	0.967	1.76 (1.18-3.10)	0.009	1.98 (1.20-3.19)	0.004
History of solid or hematologic malignancy	0.71 (0.32-1.76)	0.239	0.96 (0.44-1.99)	0.174	1.23 (0.72-2.11)	0.791
Hypotension (MAP <65 mmHg) at admission	1.65 (0.73-2.80)	0.123	1.98 (0.93-3.67)	0.279	1.36 (0.88-2.33)	0.984
Desaturation (SO_2 <90%) at admission	0.99 (0.78-1.83)	0.294	0.84 (0.57-1.63)	0.464	0.91 (0.58-1.48)	0.775
Anemia before discharge	1.06 (0.72-1.94)	0.740	1.33 (0.94-2.18)	0.097	1.73 (0.94-2.49)	0.141
Leukocytosis at admission (WBC >11 $\times 10^9$/L)	1.25 (0.48-2.79)	0.813	1.10 (0.69-1.71)	0.346	1.12 (0.45-1.81)	0.746
High RDW at admission (>14.5%)	1.84 (1.13-3.78)	0.031	1.91 (1.31-2.90)	0.005	1.62 (1.19-2.84)	0.001
Hypercapnia (pCO_2 >45 mmHg) before discharge	3.63 (1.26-10.44)	0.017	1.26 (1.09-2.31)	0.048	1.41 (0.94-2.17)	0.797
Acidosis (pH <7.35) before discharge	3.16 (1.18-8.45)	0.022	2.19 (1.33-4.18)	0.006	1.78 (1.21-3.12)	0.009
High creatinine (>1.4 mg/dL) before discharge	0.65 (0.28-1.60)	0.378	1.80 (1.23-2.70)	0.023	1.46 (1.27-2.83)	0.021
Length of hospital stay (>5 days)	1.01 (0.87-1.74)	0.861	0.74 (0.68-1.41)	0.651	1.13 (0.86-1.41)	0.214
Multivariate analysis						
Charlson comorbidity index >5	3.63 (1.26-10.44)	0.017	-	-	1.09 (0.28-4.82)	0.935
Congestive heart failure	-	-	0.16 (0.02-0.93)	0.043	1.96 (1.87-2.31)	0.041
Acidosis (pH <7.35) before discharge	1.16 (0.48-2.79)	0.740	0.22 (0.14-0.83)	0.001	1.69 (1.06-3.17)	0.033
High RDW at admission (>14.5%)	1.35 (1.25-8.15)	0.021	0.13 (0.08-0.59)	0.045	1.88 (1.19-2.76)	0.009
Hypercapnia (pCO_2 >45 mmHg) before discharge	1.08 (0.43-2.73)	0.864	1.04 (0.13-8.03)	0.967	-	-
High creatinine (>1.0 mg/dL) before discharge	-	-	0.26 (0.04-1.51)	0.132	3.16 (0.84-7.68)	0.083

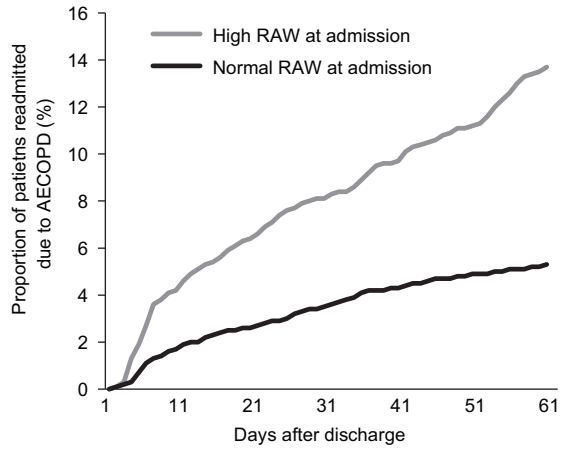

Fig.-1: *Adjusted with high Charlson comorbidity index survival curve for 60-days readmission for AECOPD according to RDW group at admission (p<0.001).*

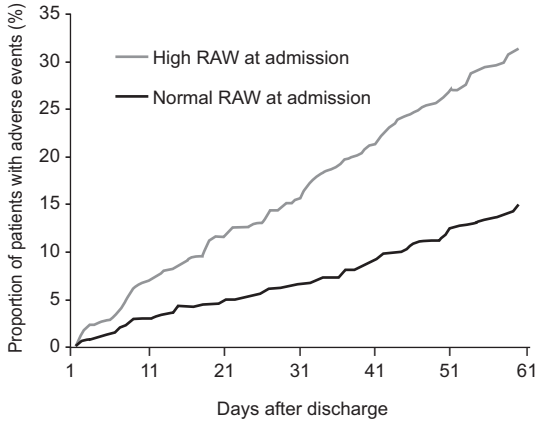

Fig.-2: *Adjusted with CHF and pH survival curve for 60-days adverse outcome (readmission or death) according to RDW group at admission (p<0.001).*

Discussion

During the study period from January 2017 to December 2018 total 180 patients were discharged from Shaheed Tajuddin Ahmad Medical College Hospital with primary diagnosis of AECOPD. Thirty four patients dropout due to died and not complete follow up. Finally 146 patients were included in the study.

In present study observed that the mean charlson comorbidity index was found 4.6±2.9 in 60 days readmission due to AECOPD and 6.6±36 in 60 days without readmission due to AECOPD. The mean RDW at admission was found 15.9±2.4 in 60 days readmission due to AECOPD and 14.7±1.8 in 60 days without readmission due to AECOPD. Majority (85.7%) patients were found hypercapnia at admission in 60 days readmission due to AECOPD and 65(49.2%) in 60 days without readmission due to AECOPD. Majority (85.7%) patients were found hypercapnia before discharge in 60 days readmission due to AECOPD and 56(42.4%) in 60 days without readmission due to AECOPD. Ten (71.4%) patients were found acidosis at admission in 60 days readmission due to AECOPD and 39(29.5%) in 60 days without readmission due to AECOPD. Seven (50.0%) patients were found acidosis before discharge in 60 days readmission due to AECOPD and 13(9.8%) in 60 days without readmission due to AECOPD. Which were statistically significant ($p<0.05$) between two group. Epstein et al.[8] observed that the mean RDW at admission and acidosis at admission were significantly higher in 60 days readmission due to AECOPD than without readmission due to AECOPD. The high rate of readmissions after an index hospitalization due to AECOPD have triggered the development and implementation of US national program that aimed to reduce these events.[9] Although numerous demographic factors and comorbidities were recognized as significant risk factors associated with early readmission, there are no published algorithms that integrate the identified risk factors into a predictive valid model that can be used during index admission [8]. Identifying AECOPD patients subject to early readmission and deployment of interventions during hospitalization are critical challenges for hospitalists.[9] The value of laboratory indexes in risk stratification of patients discharged after AECOPD was addressed only in a few studies. The only laboratory index found to be associated with early readmission is pCO_2.[10] Garcia-Aymerich et al.[11] found a significant correlation between high mean pCO_2 and readmission rate following hospitalization due to AECOPD, while Groenewegen et al.[12] identified pCO_2 as a risk factor associated with higher mortality after hospitalization due to AECOPD.

In this study observed that fourteen (37.8%) patients were found congestive heart failure in 60 days readmission from any cause and 17(15.6%) in 60 days without readmission from any cause. The

mean RDW at admission was found 15.6±2.0 in 60 days readmission from any cause and 14.8±1.8 in 60 days without readmission from any cause. Twenty three (62.2%) patients were found hypercapnia before discharge in 60 days readmission from any cause and 45(41.3%) in 60 days without readmission from any cause. Eleven (29.7%) patients were found acidosis before discharge in 60 days readmission from any cause and 9(8.3%) in 60 days without readmission from any cause. Which were statistically significant ($p<0.05$) between two group. Epstein et al.[8] reported that the male, congestive heart failure, mean RDW at admission, acidosis before discharge and creatinine at admission were significantly higher in 60 days readmission from any cause than without readmission from any cause.

In this study showed that the mean charlson comorbidity index was found 7.1±3.7 in 60 days composite end point and 5.9±3.0 in 60 days without composite end point. Fifteen (34.1%) patients were found congestive heart failure in 60 days composite end point and 16(15.7%) in 60 days without composite end point. Mean RDW at admission were found 15.6±1.8 in 60 days composite end point and 14.7±1.9 in 60 days without composite end point. Twelve (27.3%) patients were found acidosis before discharge in 60 days composite end point and 8(7.8%) in 60 days without composite end point. Which were statistically significant ($p<0.05$) between two group. Epstein et al.[8] reported mean charlson comorbidity index, congestive heart failure, mean RDW at admission, acidosis before discharge and creatinine at admission were significantly higher in 60 days composite end point than without composite end point. Recently it was increasingly investigated as a negative prognostic factor in variety of acute and chronic medical conditions, such as cardiovascular disease, venous thromboembolism, cancer, diabetes, community-acquired pneumonia, liver and kidney failure.[2] In recent years, several studies showed that increased RDW is associated with disease severity and long term mortality in COPD patients.[3,4,13]

In this study revealed that rate ratios of patients with increased RDW values and different demographic factors, co-morbidities, vital signs at admission, laboratory test results and 60-day adverse events. Similar study reported by Epstein et al.[8].

In multivariate analysis, charlson comorbidity index >5 and high RDW at admission were found to be significantly ($p<0.05$) associated with readmission due to AECOPD patients. Congestive heart failure, acidosis before discharge and high RDW at admission were found to be significantly ($p<0.05$) associated with readmission from any cause patients. Congestive heart failure, acidosis before discharge and high RDW at admission were found to be significantly ($p<0.05$) associated with composite end point patients. Epstein et al.[8] study reported RDW may serve as a biological marker for this episodic hypoxia. This theory was recently supported by Ycas et al.[14] who analyzed RDW values of more than two millions subjects and showed that acute hypoxemia could induce increase in RBC size distribution. An emergency room visit in the previous 6 months (1 versus 0) was associated with increased readmission risk with OR 1.90 (95% CI 1.01–3.58) in the study by Bashir et al.[15] and OR 1.25 (95% CI 1.21–1.29) in the study by Hakim et al.[16]. The risk of readmission increased with a greater number of previous emergency room visits (e"4 versus 0) with OR 4.37 (95% CI 1.83–10.46) and OR 2.31 (95% CI 2.23–2.39).[15,17] Previous COPD and non-COPD hospitalizations in the previous year also significantly increased the risk for 30-day readmission by 53% to 56% and 60% to 64%, respectively.[18,19]

In this study observed that high Charlson co-morbidity index survival curve for 60-days readmission for AECOPD according to RDW group at admission ($p<0.001$). Several studies showed correlation between increased RDW and right ventricle dysfunction and pulmonary hypertension.[3] It is possible; therefore, that AECOPD leads to unrecognized acute worsening of cardiac function. Increased RDW was found to be an independent predictor of right ventricle dysfunction and cardiovascular disease in patients with stable COPD.[20] Other mechanisms that may be responsible to increased RDW in patients with poor prognosis after AECOPD include increased oxidative stress, poor nutritional status and high level of inflammatory activity.[21,22] Epstein et al.[8] reported Abnormal RDW was associated with increased risk of readmission due to AECOPD in all Charlson quartiles. They used COX regression model to generate adjusted survival curves for each RDW subgroup, ($p= 0.0038$).

In present study, also observed CHF and pH survival curve for 60-days adverse outcome (readmission or death) according to RDW group at admission ($p<0.001$). Epstein et al.[8] used COX regression model to generate adjusted survival curves for each RDW subgroup, $p<0.0001$.

Limitations

There are several limitations in our study. Many of the patients with AECOPD admitted in hospital could not be included in the study due to lack of all related investigation reports. This was a single centered study with small population. Due to lack of sufficient data we in some instances failed to discriminate the mortality of some patients whether due to respiratory cause or other cause.

Conclusion:

Increased RDW levels in patients with AECOPD admitted in hospital are usually associated with an increased risk for early readmission as well as increased mortality. Raised RDW might be a novel indicator of hypoxemia, associated inflammatory response and oxidative stress in patients with AECOPD. Those patients with increased RDW should be managed with intensive care for improving their clinical outcomes and reassessment of those patients should be done for high-quality discharge decision from the hospital. This simple and inexpensive laboratory investigation may be very much useful for the prognostic information of the patients with AECOPD.

Conflicts Of Interest:

The authors declare that they have no conflict of interest.

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