

To Study the Red Cell Distribution Width in Patients of Acute Myocardial Infraction and Its Relationship with Ejection Fraction

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ABSTRACT

BACKGROUND

Red cell distribution width (RDW) is an important parameter that has a critical impact on the severity of coronary artery disease, especially on that of acute myocardial infarction (AMI). We wanted to assess red cell distribution width in patients presenting with acute myocardial infarction and its relationships with ejection fraction.

METHODS

Study was conducted on 110 patients with acute myocardial infarction, admitted at a tertiary care centre. Detailed history was obtained, and clinical examination was done. RDW and other CBC parameters were calculated by an automatic blood counter and measurement of LVEF done by 2D-echocardiography.

RESULTS

Out of 110 patients of acute myocardial infarction, 86 were male and 24 were female. In our study, there was statistically significant negative correlation between RDW and left ventricular ejection fraction in patients of acute myocardial infarction ($p < 0.01$).

CONCLUSIONS

It is observed that increase in RDW was associated with decrease in left ventricular ejection fraction in patients of CAD which is statistically significant. So, RDW can be used to assess the severity in patients with acute myocardial infarction.

KEYWORDS

Red Cell Distribution Width, Ejection Fraction, Acute Myocardial Infraction

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BACKGROUND

Acute myocardial infarction (AMI) is a disease condition characterised by electrocardiographic changes and elevated levels of biochemical indicators of myocardial necrosis. It is a major cause of disease and disability around the world. Myocardial infarction may be the first feature of coronary artery disease (CAD), or it may have repeated occurrence, in patients with the well-known disease.¹ Elevated red cell distribution width (RDW) values are independent predictors of prognosis in patients with different MI types; it has also been noted that elevated levels of RDW are associated with the presence and severity of AMI.² The correlation between RDW and AMI, heart failure, and stroke had been mentioned in some studies. Values are linked to the unfavourable outcomes in patients with MI and heart failure.³ The relation between RDW and adverse outcomes in those patients is not fully understood. Inflammation, neurohormonal, and adrenergic system activation may lead to changes in red cell maturation by distressing the red blood cell (RBC) membrane, and hence leading to increased RDW values. An association between RDW and inflammatory markers had also been stated.⁴ The aims of this study was to determine the effect of elevated RDW on the outcome of AMI in a sample of the Iraqi population.

Red cell distribution width (RDW) is a measure of the diversity of the size of red blood cells. It is one of the parameters included in routine blood counts and is thus widely available.⁵ Recently few studies shows that high red cell distribution width (RDW) has been associated with increased risk of cardiovascular disease and outcome and can be used as important marker for diagnostic and prognostic purposes in various clinical cardiovascular settings.^{2,3} Elevated RDW might be a surrogate composite measure of, multiple pathophysiological process (i.e., chronic inflammation, greater oxidative stress, nutritional deficiencies, aging) which to varying extents, might play role in the etiopathogenesis of adverse cardiovascular events.

METHODS

Study on 110 patients admitted with acute myocardial infarction in KIMS Hospital, Hubli over a period of 1 year was carried out between July 2018 to June 2019. Study was single centre prospective observational study. Patient's history taken and clinical examination done. Patient with ECG and cardiac biomarker suggestive of acute myocardial infarction both NSTEMI and STEMI were included and patient with pre-existing pulmonary, hepatic, renal, neurological, cardiac disease and anaemia. Detail history and clinical examination was done. Routine investigation including blood sugar, serum urea, creatinine, liver function test, lipid profile, CK-MB, Trop-T was done. X-Ray chest and ECG was done. In all cases, blood samples were drawn at admission before starting any medication and were collected in EDTA tubes. RDW and other CBC parameter were calculated by an automatic blood counter. The normal

reference range for RDW in this laboratory was $12.8 \pm 1.2\%$. Echocardiography was done for evaluation of left ventricular ejection fraction and regional wall motion abnormality. The data was collected and analysed by appropriate statistical test. T-statistic (Paired Test) was used for test of significance.

RESULTS

In our study out of 110 patients 86 were male and 24 were female. Female were less than male because most of female were anaemic. Highest Incidence of acute coronary syndrome noted in the age group of 50-59yr accounts for 42.09% of study patients. Lowest Incidence among both male and female noted in age group between 30-39yr. There is no female case of ACS found in the age group of 30-39 years. It may be explained by oestrogenic phase in premenopausal women (Table 1). In our study out of 110 patients of CAD 92 patients (83.3%) had RWMA noted in 2D echocardiogram. Mean RDW of patients who were presented with RWMA in 2D Echo 15.58 ± 0.74 and were not presented with RWMA in 2D Echo 14.03 ± 0.74 this is showed that high RDW positively correlate with RWMA present and negatively correlated with RWMA absent, which is highly significant ($p < 0.01$).

Age in Years	Male	Female	Total
30-39	5 (4.54%)	0	5 (4.54%)
40-49	20 (18.19%)	4 (3.6%)	24 (21.79%)
50-59	35 (31.19%)	12 (10.90%)	47 (42.09%)
60-69	14 (12.73%)	5 (4.5%)	19 (17.23%)
70 and above	12 (10.90%)	3 (2.7%)	15 (13.6%)
Total	86 (78.18%)	24 (21.9%)	110 (100%)

Table 1. Age and Sex Wise Distribution of Patients

RWMA	Number of Patients	%
Present	92	83.6
Absent	18	16.3
Total	110	100

Table 2. Distribution According to Presence of RWMA in Acute MI Patient

RWMA			
	Positive	Negative	P value
Mean \pm SD	15.58 \pm 0.75	14.03 \pm 0.68	<0.01

Table 3. Mean \pm SD of Red Cell Distribution Width According to RWMA

Ejection Fraction	Number of Patient	Mean \pm SD
>55%	18	14.03 \pm 0.68
45-55%	38	14.88 \pm 0.84
35-45%	23	15.63 \pm 0.75
<35%	13	16.24 \pm 0.74

Table 4. Correlation of Ejection Fraction with Mean \pm SD of RDW

In our study total 110 patients of CAD divided them according to Ejection fraction of the patient. It was divided into 4 groups and mean RDW of each group was noted. It showed that as the ejection fraction decreases RDW value Increases which is statistically significant.

DISCUSSION

Cardiovascular disease will be the most common cause of mortality and morbidity in India by 2020. There is growing demographic and epidemiological transition in low- and middle-income countries like India. Various studies suggested that RDW can be a useful marker for predicting mortality and outcome in patients with acute and chronic heart failure, peripheral artery disease, stroke, acute pulmonary embolism, and pulmonary arterial hypertension.⁶⁻⁹ Red cells are the primary oxygen delivery organelles to the tissue, their health being determine the wellbeing of tissue. Increase RDW is associated with increase variations in size of RBC, these RBC are more vulnerable to haemolysis and their oxygen carrying capacity is reduced therefore, reduced perfusion or reduced oxygen supply of cardiac muscles. Still pathophysiological mechanism that support the link between RDW and cardiovascular disease is not clear, but some theory suggests that inflammatory state are strongly related to ineffective erythropoiesis and it has been demonstrated that inflammatory cytokine such as tumour necrosis factor (TNF- α), interleukin 1 \pm and IL-6 desensitize bone marrow erythroid progenitors to erythropoiesis, inhibit RBC maturation and thereby promote anisocytosis or increased RDW.^{10,11} On other hand oxidative stress is effective to decrease erythrocyte life span and make them more vulnerable to haemolysis leads to increase erythropoiesis and increase release of immature cell in peripheral blood that's why RDW become high.¹²

The red cell distribution width (RDW), reflecting mean corpuscular volume heterogeneity, is an early parameter of iron deficiency, sideroblastic, vitamin B12, and folic acid deficiencies.¹³ In patients with stable coronary artery disease, higher red cell distribution width (RDW), an index of anisocytosis, corresponds to higher comorbidity burdens (diabetes mellitus, heart failure, atrial fibrillation, peripheral vascular disease, and chronic kidney disease) and is an independent predictor of mortality.¹⁴ The mentioned comorbidities are associated with a pro-inflammatory state and oxidative stress. Oxidative stress impairs membrane fluidity of the erythrocytes, reducing the life span of the red blood cells, and inflammation is known to block iron metabolism and erythropoietin response. Increased RDW is associated with impaired microvascular perfusion, causing hypoxia even in patients without anaemia.¹⁴ RDW was an independent predictor of death in patients with a previous myocardial infarction or stroke and of death secondary to cardiovascular diseases.^{15, 16}

In our study out of 110 patients 86 (78.1%) were male and 24 (21.9%) were female. Out of 110 patients 86 were male, 24 were females, among 86 males 38 patients were having diabetic, 29 patients were HTN and about 18 patients had both. Among 24 females 6 were having HTN, 12 patients were diabetic, and 4 patients had both diabetes mellitus and hypertension. Among 86 male patients 42 were smokers, 18 members were alcoholic 12 members were had both habits. None of the female were alcoholic and smokers. It was

showing that patient with risk factor having increased risk of myocardial infarction.

Out of 110 patients of CAD 92 patients (83.3%) had RWMA present in 2D-Echo. Mean RDW of patients who were presented with RWMA in 2D-Echo 15.58 ± 0.75 and who were not presented with RWMA in 2D-Echo 14.03 ± 0.68 , this observation shows statistically significant correlation between RDW and presence of RWMA (p value < 0.01). In our study ejection fraction of CAD patient divided then mean RDW of the patients belongs to that group was calculated. It showed that as the ejection fraction decreases RDW increases indicating the reciprocal correlation between two. other study by Cavusoglu E et al, Dabbah S et al, Uysal OK et al not include RWMA parameter in their study.¹⁷⁻¹⁹ Our study showed that high RDW was negatively correlated with LVEF which is statistically significant (P value < 0.01) in acute MI patients. There are limited numbers of study shows the correlation between RDW and LVEF in acute MI by indirect way. Uyarel H et al showed a significant association between elevated admission RDW level and adjusted risk of cardiovascular mortality (hazard ratio: 1.831, 95% confidence interval: 1.034-3.24, $P=0.03$).²⁰ In contrast to our study Covusoglu E et al showed that there was not significant correlation between high RDW and LVEF, in patients of acute MI. ($P = 0.0827$). Dabbah S, et al showed that there was not significant correlation between high RDW level and LVEF in patients of acute MI. ($P=0.06$).¹³ Decreased LVEF may be due to reduced perfusion of heart in acute MI patient or it may be due to high RDW which is associated with increase variation of size of RBC, these RBC more vulnerable to haemolysis and their oxygen carrying capacity are reduced so reduced perfusion or reduced oxygen supply to cardiac muscle. So, there was significant negative correlation between cardiac performance marker like LVEF and RDW as shown by our study. We mentioned that elevated RDW was associated with worse clinical outcomes in patients suffering from coronary disease, CAD or AMI.²¹

CONCLUSIONS

It is observed that increase in RDW is associated with decrease in left ventricular ejection fraction in patients of CAD which is statistically significant. So, RDW can be used to assess the severity in patients with acute myocardial infarction.

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