

Research Article

To study the correlation between red cell distribution width and left ventricular ejection fraction in patients of acute myocardial infraction

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ABSTRACT

Background: Ischemic heart disease (IHD) is a condition in which there is an inadequate supply of blood and oxygen to a portion of myocardium. The objective of study was to assess the correlation between red cell distribution width and left ventricular ejection fraction in patients presenting with acute myocardial infarction.

Methods: Study was conducted on 200 patients admitted at tertiary care centre with acute myocardial infarction satisfying inclusion criteria. Detailed history 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 200 patients of acute myocardial infarction 178 (89%) were male and 22 (11%) were female. Both RDW and LVEF are linked in patients of acute myocardial infarctions, as there was statistically significant correlation between high RDW and low LVEF ($P < 0.01$, r - value 0.432).

Conclusions: It is observed that increase RDW and decrease LVEF were linked together which is statistically significant. RDW can be used to assess severity and outcome in patients of acute myocardial infarction on their initial presentation especially at peripheral health centre where echocardiography is not available routinely.

Keywords: Red cell distribution width, Left ventricular ejection fraction, Regional wall motion abnormality

INTRODUCTION

Ischemic heart disease (IHD) is a condition in which there is an inadequate supply of blood and oxygen to a portion of myocardium. According to global burden of disease update 2004, IHD is most common cause of death worldwide. Severity and outcome of IHD is usually assessed by measuring left ventricular ejection fraction (LVEF) by 2D-Echocardiography which play a key role in many strategies for managing patients of the acute myocardial infarction.

In low and middle income countries facility of echocardiography is not available routinely at city hospital and peripheral health centers so there is a need of

simple and inexpensive marker by which we can assess the LVEF at initial presentation of patient with acute myocardial infarction. It is well known that atherosclerosis play important role in IHD and it is a state of inflammation.¹ 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.

RDW is an easy and inexpensive tool; it is an index of variation in cell volume within the red cell population. Because of automation it is easy to determine and it is routinely assessed as part of the complete blood count (CBC). It is a parameter provided by automated hematology analyzers and is the electronic equivalent of anisocytosis or variation in red blood cell size that is judged by smear examination. It means when elevated RDW is reported on complete blood count, marked anisocytosis (increased variation in red cell size) is expected on peripheral blood smear examination. The normal reference range of the RDW typically spans between 11% and 14%. A variety of diseases might however determine a significant variation of the RBC size, generating a high RDW whose upper limit is generally set at the 95th percentile of RDW for the general population. It may be used as surrogate marker in making strategy for management of patients after acute MI and reducing mortality after acute MI especially at centre where echocardiography facilities are not available routinely. In our study we focused on correlation between RDW and Left Ventricular Ejection Fractions in patients of acute myocardial infarction so measurement of RDW in patients of acute myocardial infarction can be used for risk stratification of patients.

METHODS

Study on 200 patient admitted with acute myocardial infarction in S.M.S. Hospital, Jaipur over a period of 1 year was carried out. Patients with ECG and cardiac biomarker suggestive of acute myocardial infarction both NSTEMI and STEMI were included and patient with preexisting pulmonary, hepatic, renal, neurological, cardiac disease and anemia with deficiency of serum vitamin B₁₂, serum folic acid, serum iron were excluded. Detail history and clinical examination was done. Routine investigation including blood sugar, serum urea, creatinine, liver function test, lipid profile, serum iron, serum folic acid and serum vitamin B₁₂ and CPK-MB and 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 Tripotassium 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±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. Quantitative data were analysed by using χ^2 -test (chi square).

RESULTS

In our study out of 200 patients 178 (89%) were male and 22 (11%) were female. Female were less than male because most of female were anemic. Highest incidence of Acute Coronary Syndrome was noted in age group of

50-59, male (33.7%) and female (54.54%). Lowest incidence among male was noted in age group above 70 years (8.42%) and there is no case of ACS found in female age group of 30-39 years. It may be explained by oestrogenic phase in premenopausal women (Table 1).

Table 1: Distribution according to age and sex of patients.

Age group (in years)	Sex		Total
	Male	Female	
30-39	24 (12.00)	0 (0.00)	24 (12.00)
40-49	55 (27.50)	3 (1.50)	58 (29.00)
50-59	60 (30.00)	12 (6.00)	72 (36.00)
60-69	24 (12.00)	5 (2.50)	29 (14.50)
70+	15 (7.50)	2 (1.00)	17 (8.50)
Total	178 (89.00)	22 (11.00)	200 (100.00)

Out of 200 patients of CAD 150 patients (75%) had RWMA noted in 2D-Echo. Mean RDW of patients who were presented with RWMA in 2D-Echo 15.44±0.74 and who were not presented with RWMA in 2D-Echo 14.83±0.87 this shows that high RDW positively correlated with RWMA present and negatively correlated with RWMA absent. Which is highly significant (p<0.001) (Table 2 and 3).

Table 2: Distribution according to presence of RWMA on acute MI patient.

RWMA	Number	%
Present	150	75.00
Absent	50	25.00
Total	200	100.00

Table 3: Mean±SD of RDW according to RWMA.

	RWMA		p-value	Significance
	Positive	Negative		
Mean ±Sd	15.44±0.74	14.83±0.87	<0.001	HS

In our study RDW and LVEF are linked together in patients of acute myocardial infarction as high RDW negatively correlated with LVEF which is statistically significant (Table 4).

Table 4: Correlation between RDW and LVEF (%).

Correlation	r-value	P-value	Significance
RDW versus LVEF (%)	-0.432	< 0.01	Sig

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.³⁻⁸

Red cells are the primary oxygen delivery organelles to the tissue, their bell being determine the wellbeing of tissue. Increase RDW is associated with increase variations in size of RBC, these RBC are more vulnerable to hemolysis 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 tumor necrosis factor (TNF- α), interleukin 1 \pm and IL-6 desensitize bonemarrow erythroid progenitors to erythropoiesis, inhibit RBC meturation and thereby promote anisocytosis or increased RDW.^{9,10} On other hand oxidative stress is effective to decrease erythrocyte life span and make them more vulnerable to hemolysis leads to increase erythropoesis and increase release of immature cell in peripheral blood that's why RDW become high.¹¹

In our study out of 200 patients 178 (89%) were male and 22 (11%) were female. This could be explained by higher incidence of anemia in female in developing countries like India. Out of 200 patients of CAD 150 patients (75%) had RWMA present in 2D-Echo. Mean RDW of patients who were presented with RWMA in 2D-Echo 15.44 ± 0.74 and who were not presented with RWMA in 2D-Echo 14.83 ± 0.87 , this observation shows statistically significant correlation between RDW and presence of RWMA (Pvalue <0.001). In other study by Cavusoglu E et al, Dabbah S et al, Uysal OK et al not include RWMA parameter in their study.¹²⁻¹⁴ Our study showed that high RDW was negatively correlated with LVEF which is statistically significant (P value <0.01, r – value 0.432) 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).¹⁵ 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.¹² (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 hemolysis 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.

CONCLUSION

It is observed that increased RDW and decreased LVEF are linked together which is statistically significant so RDW can be used to assess severity and outcome in patients of acute myocardial infraction especially at peripheral health centre on their initial presentation, where echocardiography is not available routinely. Long scale community based study on general population would have been more informative.

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REFERENCES

1. Libby P, Ridker PM, Maseri A. Inflammation and atherosclerosis. *Circulation.* 2002;105:1135-43.
2. Isik T, Ayhan E, Kurt M, Tanboga IH, Kaya A, Aksakal E. Is Red Cell Distribution Width a Marker for the presence and Poor Prognosis of Cardiovascular Disease ? *EAJM.* 2012;44(3):169-71.
3. Felker GM, Allen LA, Pocock SJ, Shaw LK, McMurray JJ, Pfeffer MA. Red cell distribution width as a novel prognostic maker in heart failure J. *Am Coll Cardiol.* 2007;50(1):40-7.
4. Oh J, Kang SM, Hong N, Choi JW, Lee SH, Park S, et al. Relation Between Red Cell Distribution Width with Echocardiographic Parameters in Patients with acute heart failure journal of Cardiac Failure. 2009;15(6):517-22.
5. Zalawadiya SK, Veeranna V, Panaich SS, Afonso L. 2012 Red cell distribution width and risk of peripheral artery disease : analysis of National Health and Nutrition Examination Survey 1999-2004. *Vasc Med* 2012;17(3):155-63.
6. Ani C, Ovbiagele B. Elevated red blood cell distribution width predicts mortality in persons with known stroke. *J Neurol Sci* 2009;15;277(1-2):103-8.
7. Zorlu A, Bektasoglu G, Guven FM, Dogan OT, Gucuk E, Ege MR, et al. Usefulness of admission red cell distribution width as a predictor of early mortality in patients with acute pulmonary embolism. *Am J Cardiol Epub.* 2012;1;109(1):128-34.
8. Hampole CV, Mehrotra AK, Thenappan T, Gomberg-Maitland M, Shah SJ. Usefulness of red cell distribution width as a prognostic marker in pulmonary hypertension. *Am J Cardiology.* 2009;15;104(6):868-72.
9. Macdougall IC, Copper A. The inflammatory response and epoetin sensitivity. *Nephrol Dial Transplant.* 2002;17 Suppl 1:48-52.

10. Levine B, Kalman J, Mayer L, Fillit HM, Packer M. Elevated circulating levels of tumor necrosis factor in severe chronic heart failure. *N Engl J Med.* 1990;26;323(4):236-41.
11. Marinkovic D, Zhang X, Yalcin S, Luciano JP, Brugnara C, Huber T et al. Foxo3 is required for the regulation of oxidative stress in erythropoiesis. *J Clin Invest* 2007;117(8):2133- 44.
12. Cavusoglu E, Chopra V, Gupta A, Battala VR, Poludasu S, Eng C, et al. Marmur. Relation between red blood cell distribution width (RDW) and all-cause mortality at two years in an unselected population referred for coronary angiography – international Journal of Cardiology. 2010;141(2):141-6.
13. Dabbah S, Hammerman H, Markiewicz W, Aronson D. Relation Between Red Cell Distribution Width and Clinical Outcomes After Acute Myocardial infraction *Am J Cardiology* 2010;105:312-7.
14. Uysal OK, Duran M, Ozkan B, Sahin DY, Tekin K, Elbasan Z, et al. Red cell distribution width is associated with acute myocardial infarction in young patients *Cardiology Journal.* 2012;19(6):597-602.
15. Uyarel H, Ergelen M, Cicek G, Kaya MG, Ayhan E, Turkkan C, et al. Red cell distribution width as a novel prognostic marker in patients undergoing primary angioplasty for acute myocardial infarction. *Coron Artery Dis.* 2011;22(3):138-44.

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