EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

RED BLOOD CELL DISTRIBUTION WIDTH (RDW) AS A PREDICTIVE BIOMARKER FOR PATIENTS WITH MYOCARDIAL INFARCTION IN SUDAN

Eman Elimam Diab[1], Elharm Ibrahim Abdallah[1] and Mohamed Mobarak Elbasheir[2]*

[1]Department of Haematology & Immunohaematology, Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum State, Sudan.
[2]Department of Parasitology & Medical Entomology, Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum State, Sudan.

*Corresponding Author: Mohamed Mobarak Elbasheir
Department of Parasitology & Medical Entomology, Faculty of Medical Laboratory Sciences, Alzaiem Alazhari University, Khartoum State, Sudan.

ABSTRACT

Background: Red blood cell distribution width (RDW) is a simple and inexpensive parameter, which measures the range of variation of erythrocyte volume (anisocytosis) and routinely used in complete blood count for differential diagnosis of anaemias. Emerging reports suggest a usefulness of RDW in multiple clinical applications, including coronary artery disease (CAD). Therefore, early detection and intervention in time of these vascular diseases is critical for delaying their progression. So, the current study is aimed to assess the predictive value of RDW in the diagnosis of Myocardial infarction. **Materials and Methods:** One hundred and twenty individuals (mean age 58.5 years, 70 males, 50 females) in Khartoum state were enrolled into this study. They divided into (60 patients with known myocardial infarction admitted at AL-Shaab Teaching Hospital as a case group and 60 healthy individual as control group. All blood samples were collected in EDTA container and RDW was measured by (Sysmex KX21N) hematology analyzer, then data were analyzed by SPSS. **Results:** There was a high significant increase in RDW among cases when compared to control with *P value (0.00)*. In addition, A significant positive correlation between RDW and age among patients with myocardial infarction was observed (R value 0.465, P value 0.000) while negative correlation was detected in control group (R value − .067, P value 0.617). **Conclusions:** RDW is a simple biomarker that could be used for early prediction of myocardial infarction and furthermore for prognosis of patients with heart disease.

KEYWORDS: Red cell distribution width, Myocardial Infarction, Predictive Biomarker.

INTRODUCTION

Myocardial infarction (MI) is a type of acute coronary syndrome, also known as a heart attack, occurs when blood flow decreases or stops to a part of the heart, causing damage to the heart muscle,[1] When there is evidence of an MI, it may be divided to an ST elevation myocardial infarction (STEMI) or Non-ST elevation myocardial infarction (NSTEMI) depended on the results of an ECG.[1] Atherosclerosis is characterized by progressive inflammation of the walls of the arteries.[2] Exposed to blood flow, plaques may rupture and trigger the formation of a blood clot (thrombus).[2]

The red blood cell distribution width (RDW) is a rather simple measure of RBC size heterogeneity, which is calculated by dividing the standard deviation (SD) of erythrocyte volumes for the mean corpuscular volume (MCV). (RDW= (standard deviation of red blood cell volume/mean cell volume) × 100).[3]

RDW increase in cardiovascular diseases because of induced erythropoiesis by erythropoietin that helps the release of larger RBCs from bone marrow.[4] The erythrocytes have large amounts of free cholesterol, and abnormal changes in the membrane may lead to accumulation of erythrocytes within the plaque.[5] The chronic inflammatory state may induce erythropoiesis.[6] A number of pro inflammatory cytokines are efficient to inhibit EPO production and RBC maturation, thus lead to anisocytosis.[7,8] Incidence of cardiovascular diseases has become increased and the occurrence of the disease increase mortality.

Red cell distribution width is a known marker for erythrocyte disorders. However, recent studies propose a high value of RDW in multiple clinical applications, particularly cardiovascular diseases. Therefore the current study is aimed to determine RDW in MI patients and healthy individuals in order to assist the diagnosis of myocardial infarction.

MATERIALS AND METHODS
Ethical consideration
Approval for this study was obtained from Ethical committee of ALzaeim ALazhari University, federal ministry of health (Ethical Committee, Protocol No. 12/2019) and permission from the administrators of Alshaab teaching hospital. Research purpose and objectives were explained to participant in a clear simple words. Participant has right to voluntary, informed consent and the data were obtained with privacy.

Study design and population
A cross sectional study design was done in Khartoum state among 120 (60 cases + 60 controls). Case group was from known patients with myocardial infarction who were admitted at Alshab teaching hospital in Cardiac Unit, while the control group were apparently healthy blood donors. Both gender; 70 males, 50 females and age between 34 to 80 years old (mean age 58.5 years) were enrolled into the study. Patients with different type of anaemia and haemoglobin disorders were excluded.

Sample collection and laboratory procedures
120 blood samples were collected in EDTA container during the period from October to December 2019. RDW was measured by (Sysmex KX21N) hematology analyzer which is obtained by dividing the haematocrit for the RBC count. The RDW is then calculated at a relative height of 20% above the baseline of RBC histogram.

Data Analysis
Data were analysed using SPSS version 21.0 software (SPSS for Windows). Independent T test at 5% level of significant was performed to determine RDW in case and control groups. The correlation of RDW and age/years was tested using logistic linear regression with associated 95% confidence interval (CI).
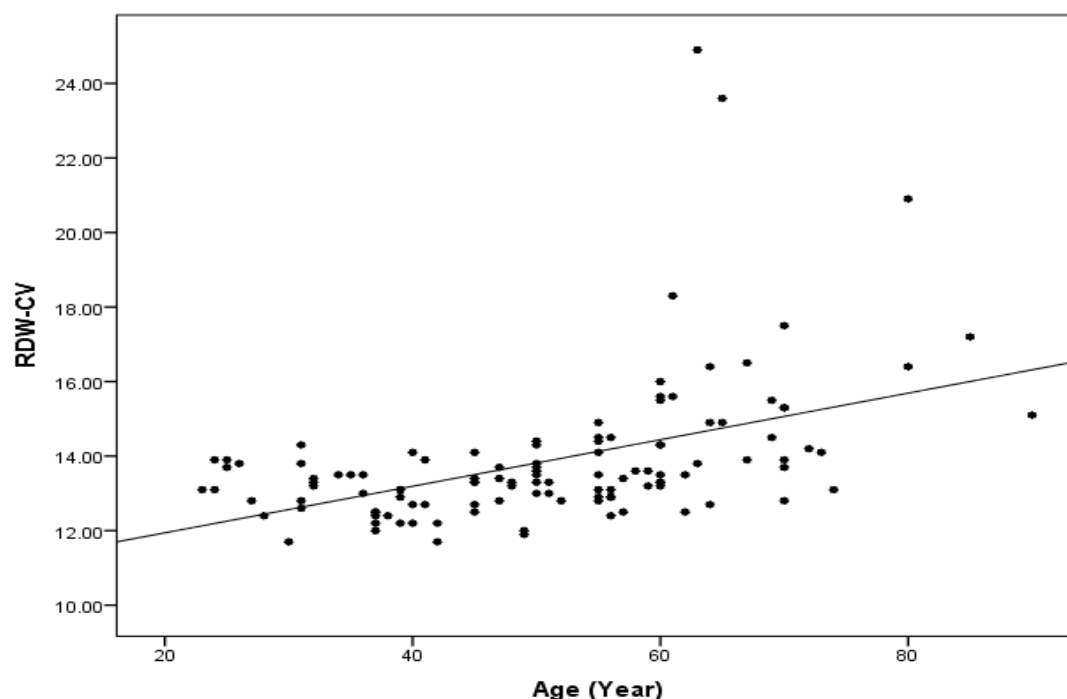
RESULTS
The result revealed that there was a high significant increase in RDW among patients with myocardial infarction when compared to control group with mean (14.78 versus 12.95) respectively with (P value 0.00) Table (1).

In addition, there was a significant positive correlation between RDW and age among patients with myocardial infarction (R value 0.465, P value 0.000). Analysis also showed that patients with high RDW value were older, Figure 1. Conversely insignificant negative correlation between RDW and age was observed among control group. (R value -.067, P value 0.617), Figure 2.
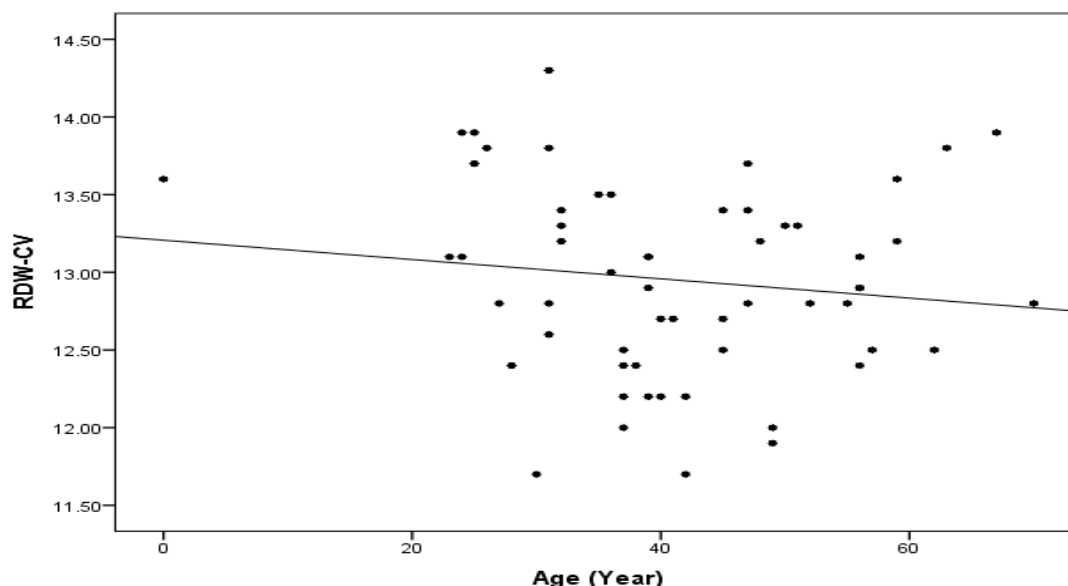
Table (1): Mean differences of RDW in case and control groups.

Variable	Case / Mean	Control/ Mean	P value
RDW	14.788±2.340	12.950± 0.611	**0.000**

- T-test was used to calculate P value
- P value less than 0.05 considered significant
- Mean ± Standard deviation

Figure 1: Correlation of age (years) and RDW among case group.

Figure 2: Correlation of age (years) and RDW among control group.

DISCUSSION

The result showed the mean of RDW in myocardial infarction patients 14.8 versus 12.95 in control group with significant difference (P value 0.00). This increased in RDW among patients with myocardial infarction may be due to; erythrocytes contain large amounts of free cholesterol, and abnormal changes in the erythrocyte membrane lead to anisocytosis (difference in cells size).[5] Also, RDW may increase in cardiovascular diseases duo to efficient stimulation of erythropoiesis by erythropoietin which helps the release of enlarged RBCs (macrocytes) (Reticulocytes) from bone marrow in addition to the presence of normocyte which give picture of anisocytosis.[4] this result was agreed with previous study done by Ryo Nishio*et al,* with the mean (13.6) in case group vs (12.5) in control group p < 0.000.[9] The current results also was agreed with the reports observed by Tove Skjelakken, *et al*, whom they found that there was association between patients with Myocardial infarction and RDW value.[10]

Other study done by Elisa Danese*et al*, was in concordance with this study with the mean (15.1 in cases % *vs* 13.5% in controls), P<0.001) which revealed a significant increased in RDW among myocardial infarction patients than non acute coronary syndrome.[11] The present study revealed an increased RDW was positively correlated with age group which explain why rate of death was higher among elder patients which in line with results reported other authors.[12]

The present study concluded that; RDW is simple biomarker and might be useful in conjunction with other cardiac markers in early predication of the risk of myocardial infarction in patients admitted to the emergency department, so could be used as routine investigation and furthermore for prognosis of patients with myocardial infarction.

REFERENCES

1. Thygesen K, Alpert JS, Jaffe AS, et al. Third universal definition of myocardial infarction. Circulation, 2012; 126(16).
2. Woollard KJ, Geissmann F. Monocytes in atherosclerosis: subsets and functions Nature Reviews. Cardiology, 2010; **7**(2): 77–86.
3. Danese E, Lippi G, Montagnana M. Red blood cell distribution width and cardiovascular diseases. *J Thorac Dis*., 2015; 7(10): E402–E411.
4. Yčas JW, Horrow JC, Horne BD. Persistent increase in red cell size distribution width after acute diseases: A biomarker of hypoxemia? Clin Chim Acta, 2015; 448: 107-17.
5. Yeagle PL. Cholesterol and the cell membrane. Biochim Biophys Acta, 1985; 822: 267–287.
6. Inuzuka R, Abe J. Red blood cell distribution width as a link between ineffective erythropoiesis and chronic inflammation in heart failure. Circ J., 2015; 79: 974-5.
7. Macdougall IC, Cooper A. The inflammatory response and epoetin sensitivity. Nephrol Dial Transplant, 2002; 17(1): 48-52.
8. Lippi G, Targher G, Montagnana M, et al. Relation between red blood cell distribution width and inflammatory biomarkers in a large cohort of unselected outpatients. Arch Pathol Lab Med, 2009; 133: 628-632.
9. Thygesen K, Alpert JS, Jaffe AS, Simoons ML, Chaitman BR, White HD, et al. Third universal definition of myocardial infarction. Circulation, 2012; 126(16): 2020–35.
10. Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, White HD. Fourth universal

definition of myocardial infarction (2018). *European Heart Journal*, 2019; 40(3): 237–269.

11. O'Gara PT, Kushner FG, Ascheim DD, Casey DE, Chung MK, de Lemos JA, et al. "ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines". *Circulation*, 2013; 127(4): e362–425.

12. Pisano C, Nardi P, Bertoldo F, Altieri C, Ruvolo G. Red Blood Cell Distribution Width as New Biomarker in Predicting Outcomes after Aortic Valve Replacement: A Retrospective Cohort Study. Clin Surg, 2019; 4: 2463.