

A study of red cell distribution width in hypertensive individuals

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Abstract

Background: Hypertension is a global health issue and is a multifactorial disorder caused by various environmental, physiological and genetic factors. Inflammation plays a major role in the development of hypertension. Research has shown that Red cell distribution width (RDW) has significant association with cardiovascular and thrombotic disorders, and cardiac mortality in patients with coronary artery disease, acute and chronic heart failure, and stroke. **Aim:** To determine RDW in hypertensive individuals and to compare this with that of normal individuals. **Materials and methods:** Thirty hypertensive individuals of both genders in the age group of 30 – 45 years were chosen from Department of General Medicine, Stanley Medical College and Hospital, Chennai. Thirty age- and gender- matched healthy controls were selected. Under strict aseptic conditions, venous blood sample was collected for measuring RDW. **Results:** The data obtained were analyzed using SPSS software version 20. From this study we found that RDW was significantly higher ($p = 0.000$) in hypertensive individuals (15.25 ± 2.06) compared to controls (13.08 ± 0.6). **Conclusion:** RDW was significantly higher in hypertensive individuals, possibly due the presence of ongoing inflammation in hypertension. Hence RDW may be included in the routine investigations for follow up of hypertensive individuals, to identify those at risk of developing cardiovascular complications so that early intervention will be possible.

Keywords: inflammation, hypertension, red cell distribution width

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Introduction

Hypertension, also known as high blood pressure, is a major global health issue due to its increasing prevalence both in developing and developed countries. According to WHO, hypertension is one of the leading causes of death worldwide.¹ In a 2005 analysis on the global burden of hypertension, 20.6% of men and 20.9% of women in India were reported to be suffering from hypertension.² By 2025, the rates are expected to rise to 22.9% and 23.6% among Indian men and women respectively.² Systemic arterial hypertension (HT) is one of the commonest health disorders with uncertain aetiology and pathophysiology. It is a multifactorial disorder caused by various

environmental, physiological and genetic factors. The endothelial dysfunction, vascular stiffness, alterations in rennin-angiotensin system, abnormal sympathetic outflow and increased plasma aldosterone levels are the major culprits involved in the pathogenesis of increased arterial pressure.³

Many inflammatory markers such as high sensitive C-reactive protein, cytokines and adhesion molecules have been found to be elevated in hypertension, indicating the role of inflammation in the development of hypertension.⁵⁻⁹ Hypertension may lead to severe end organ damage such as coronary heart disease and stroke, which contribute to mortality among the general population.⁴ Vascular

reactivity and endothelial dysfunction result in the increased peripheral vascular resistance which is implicated in the pathogenesis of hypertension. Recent evidence shows that the immune system and chronic inflammatory status may also play a role in the pathogenesis of hypertension.⁵⁻⁹

Red cell distribution width (RDW) is a parameter which is usually evaluated in a fully automated hematology analyzer, as part of the complete blood count. RDW is an important marker of anisocytosis (red cell size variation). RDW can reflect early changes in size of red blood cells, and seen in iron deficiency anemia, and have been shown to have a high sensitivity in detecting anaemia.^{10,11} It was originally used along with the mean corpuscular volume (MCV) in clinical practice to differentiate it between the causes of anaemia.

Recent studies have shown that RDW is higher in pre-hypertension and hypertension.¹² Furthermore, highly significant associations have been found between RDW values and diabetic ketoacidosis, cardiovascular and thrombotic disorders, and cardiac mortality in patients with coronary artery disease, acute and chronic heart failure, and stroke.^{13,14} Inflammation might increase RDW levels via impairment of iron metabolism and disruption of the response to erythropoietin. This could impair erythrocyte maturation and cause immature red blood cells to enter into the circulation. This aim of study was to determine the red cell distribution width in hypertensive individuals and to compare this with normal individuals.

Materials and Methods

After obtaining Institutional Ethical Committee approval, the study was conducted in Govt. Stanley Medical College and Hospital, Chennai. Thirty hypertensive individuals in the age group of 30 to 45 years of both genders diagnosed with hypertension according to JNC VII criteria were selected from hypertension OPD, Department of General Medicine, Stanley Medical College and Hospital, Chennai. Thirty age- and gender- matched healthy controls were selected from the group of technicians, staff and willing patient attendants.

Inclusion criteria:

1. Hypertensive individuals in the age group of 30 to 45 years of both genders
2. Hypertensive individuals with disease duration of 3- 5 years.

3. Individuals without any cardiovascular complications.

Exclusion criteria

Individuals with history suggestive of the following were excluded from the study: Smoking, alcoholism, diabetes mellitus, endocrine disorders, renal failure, bronchial asthma, neurological disorders, pregnancy, obesity, any other chronic illness (underlying inflammation may cause increase in RDW values in all these conditions).

Informed written consent was obtained from all the individuals, after explaining in detail about the procedure. A detailed medical and personal history was taken. General and clinical examination was done in all the subjects who participated in the study.

Measurement of Blood Pressure: Prior to the measurement of blood pressure, caffeine and exercise were avoided. Blood pressure recording was done by the principal investigator using both palpatory and auscultatory methods. A mercury sphygmomanometer and cuff of appropriate size were used for the auscultatory method. Individuals were seated quietly for at least 5 minutes in a chair before recording the blood pressure. Three measurements were taken and the average of the three readings was taken as the blood pressure. Height (Ht) in cm and weight (wt) in kg were measured. BMI was calculated using the Quetelet's formula – wt in kg/ Ht in m².

Blood Sample Collection: 2ml of venous blood was collected from both hypertensive and normal individuals. Red cell distribution width was determined using automated hematology analyzer – SYSMEX, in the central lab, Department of Pathology, Stanley Medical College and Hospital, Chennai.

Statistical analysis: The data obtained were analyzed using SPSS software version 20. Independent student t test was employed to compare the means of variables between study and control groups and p value < 0.01 was taken as significant.

Results

The characteristics of control and hypertensive individuals are presented in Table 1. Hypertensive individuals and the control group were in the age group of 30 – 45 years. The mean age in years of the control group was 40.24 ± 2.48, and that of the hypertensive group was 40.33 ± 3.48. The mean BMI in the control group was 23.25 ± 1.08 and in the

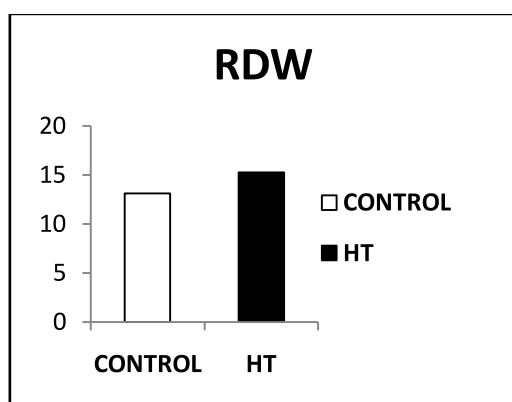
hypertensive group it was 23.82 ± 1.49 . With regard to age and BMI, the distribution of subjects in the hypertensive and control groups was uniform.

Table 1: Characteristics of control and hypertensive individuals

Variables	Controls	Hypertensive group
Age (years)	40.24 ± 2.48	40.33 ± 3.48
BMI(kg/ m2)	23.25 ± 1.08	23.82 ± 1.49 .
SBP mm Hg	111.93 ± 5.66	154.66 ± 9.26
DBP mm Hg	73.66 ± 3.48	92.86 ± 5.19
MAP mm Hg	86.41 ± 8.38	113.36 ± 10.94

The comparison of mean values of RDW between the control and hypertensive groups is shown in Figure 1. In the control group the RDW was 13.08 ± 0.69 whereas the mean RDW in hypertensive individuals was 15.25 ± 2.06 with a p value of 0.000.

Figure 1: Comparison of mean value of RDW between control and hypertensive individuals



The comparison of mean values of RDW between the control and hypertensive groups. In the control group the RDW was 13.08 ± 0.69 whereas the mean RDW in hypertensive individuals was 15.25 ± 2.06 with a p value of 0.000; p value < 0.01 was considered significant.

Discussion

The main aim of the present study was to compare the values of RDW between hypertensive individuals and controls.

The mean age in years in hypertensive individuals was similar to the mean age of the controls. The mean BMI of the hypertensive individuals (23.82 ± 1.49) was similar to the mean BMI of the controls (23.25 ± 1.08). With regard to age and BMI the study population did not show much difference and hence both the groups were comparable. From this study we could find that the mean red cell distribution width was significantly higher in hypertensive individuals when compared to controls ($p < 0.01$).

Recently, Keskin and colleagues observed that in women with preeclampsia the RDW values are increased and it was associated with the severity of preeclampsia.¹⁵ RDW has been recently observed to be associated with hypertension and it suggests poor prognosis in them. In acute myocardial infarction and heart failure, RDW is an indicator of poor outcome.^{16,17,18} Though the mechanism of the relationship between RDW and hypertension is not clearly understood, heightened inflammatory response is the most plausible theory.¹⁹ Positive correlation between C reactive protein and RDW levels in preeclamptic women supports the increased inflammation theory of RDW in hypertensive individuals.¹⁵ Inflammation might increase RDW levels via impairment of iron metabolism and disruption of the response to erythropoietin.²⁰ This could impair erythrocyte maturation and cause immature erythrocytes to enter the circulation.^{20,21}

Higher RDW in hypertensive patients compared to healthy controls indicates the presence of anisocytosis, which may be related to impairment of erythropoiesis and degradation of erythrocytes by fragmentation or agglutination.^{25,26} This occurs in the presence of chronic inflammation and increased levels of oxidative stress.²⁷

Recent studies have investigated changes in RDW in association with cardiac and noncardiac deaths. Most of these studies report a positive correlation of RDW with the erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels – which correlates with an increase in the RDW during inflammation, similar to that seen in other inflammatory parameters.

The relationship between RDW and atherosclerosis may be that due to oxidative stress, inflammation, and increased cholesterol in erythrocyte membrane, erythrocyte malformation results, increasing RDW levels. Inflammation or oxidative stress might also contribute to an increased RDW by impairing iron metabolism, inhibiting the production of or response

to erythropoietin, and shortening red blood cell survival.^{22,23} Lippi *et al*²⁴ stated that there is an increase in RDW levels during acute coronary syndrome and they also showed the clinical usefulness of RDW for the risk stratification of these patients over a period of 1 year.

In Hypertension, increased vascular inflammation and oxidative stress affects erythropoiesis and deformability of red blood cells thus leading to elevated RDW levels. RDW is associated with chronic inflammation and it is a strong indicator of risk of cardiovascular mortality in people with hypertension and cardiovascular disease as well as in the general population.

Elevated RDW is not only an indicator but also a good prognostic marker in reflecting the underlying inflammatory state.²⁸ High RDW has been strongly associated with poor clinical outcomes in patients with heart failure,²⁸ coronary artery disease,^{29,30} pulmonary hypertension³¹ and peripheral arterial disease.³² Increased RDW is also associated with increased mortality in diabetic patients with coronary artery disease treated with percutaneous coronary intervention.³³

Conclusion

RDW was significantly higher in hypertensive individuals when compared to that of normal controls, suggesting the presence of ongoing inflammation in Hypertension. RDW is an easy, inexpensive, routine investigation, which might allow the acquisition of significant diagnostic and prognostic information in patients with hypertension may be included in the routine investigations during the follow up of hypertensive individuals, to identify those at risk of developing cardiovascular complications so that early intervention will be possible. The study may be conducted in a larger sample size and apart from RDW other inflammatory markers may also be studied in the future.

Acknowledgment: Nil

Conflicts of interest: Nil

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