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Original Research Article

Relationship between red cell distribution and acute heart failure in patients of one of the tertiary care centres, Gujarat

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ABSTRACT

Background: Red cell distribution (RDW) is a marker of anisocytosis, inflammation and ageing. It used to differentiate anemias and is associated with chronic conditions such as chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), malignancy, irritable bowel syndrome (IBS) etc. Aim and objectives were to study/compare RDW in patients of heart failure (HF) and healthy individuals, to observe values of RDW in patients of acute HF and controls (as per exclusion criteria), to study relationship between RDW and HFREF/HFPEF and to study correlation of RDW and age of subjects.
Methods: This is an observational cross-sectional comparative hospital-based study with 105 sample size conducted in tertiary care center for the duration of 1 year.
Results: Of the total 105 patients, 35 were control (healthy individuals) and 70 patients of HF (from which 48 had HFREF and 22 had HFPEF). The gender distribution was 40.4% females and 59.6% males. There is positive correlation between RDW and age of the case (Pearson correlation 0.0138 and p=0.0002). In the HFREF subgroup 35 participants and in HFPEF 16 participants were >13.6 RDW distribution. There was no significant difference in RDW distribution among two subgroups of HF cases.
Conclusions: RDW is a novel and cheap marker that can be used to diagnose Heart. Longitudinal serial assessment of RDW in cases of HF might provide the severity of the disease and can help predict adverse outcomes. In rural areas, with unavailability of 2D echocardiography/expensive investigations (NTProbnp), HF can reliably be diagnosed based on raised values of RDW coupled with clinical presentation.

Keywords: RDW, Acute HF, Comorbidities, Heart diseases

INTRODUCTION

As a complex clinical syndrome, HF is characterized by certain symptoms and signs such as dyspnoea and fatigue, which impair exercise tolerance, fluid retention, and may provoke pulmonary and/or splanchnic congestion, ankle swelling, peripheral oedema, elevated jugular venous pressure, and pulmonary crackles.[1,2] The classification of the different types of HF is based on left ventricle ejection fraction (LVEF) as follows: 1. HF with preserved LVEF (HFpEF), i.e., patients with normal LVEF (≥50%); 2. HF with reduced EF (HFrEF), i.e., patients with reduced LVEF (<40%).[1]

The causative factors of HF are speckled, including an extensive range of pathologies both cardiovascular and non-cardiovascular. In majority of patients, they will suffer from dissimilar illnesses at the similar time, which ultimately prompt the HF. Nevertheless, a history of ischemic heart disease (IHD) and myocardial infarction or revascularization is very mutual among patients with HF.[3] The red blood cell distribution width is a simple,

rapid, inexpensive and forthright hematological parameter, reliably imitating the degree of anisocytosis in vivo. The current epidemiological and biological evidence recommends that longitudinal assessment of red blood cell distribution width over time may be reflected an efficient measure to help forecasting the risk of both development and progression of HF.[4] The elder age is also a robust causative factor for cardiac dysfunction. Therefore, the existing substantiation suggests that anisocytosis and HF may segment many pathogenetic mechanisms, which may clarify why both conditions may progress and progress in parallel, thus making RDW a reliable marker of cardiac dysfunction.[5] Nevertheless, anisocytosis may also play a direct role in the onset and progressive worsening of HF.

Abnormal erythrocytes may also actively participate in the pathogenesis of cardiac fibrosis through promotion or amplification of inflammation, cardiomyocyte stress and apoptosis.[6] RDW is quantitative measure of anisocytosis. i.e., the variability in size of circulating red cells, and is routinely reported by automated laboratory equipment used to perform complete blood counts (CBC).[7]

Regarding the biological interplay between impaired hematopoiesis and cardiac dysfunction, many of the different conditions associated with increased heterogeneity of erythrocyte volume (i.e., ageing, inflammation, oxidative stress, nutritional deficiencies and impaired renal function), may be concomitantly present in patients with HF, whilst anisocytosis may also directly contribute to the development and worsening of HF. In conclusion, the longitudinal assessment of RDW changes over time may be considered an efficient measure to help predicting the risk of both development and progression of HF.[8]

Aims and objectives

Aim and objectives were to study and compare RDW in patients of HF and healthy individuals, to observe values of RDW in patients of acute HF and non-HF patients, to study relationship between RDW and 2D echo parameters of acute HF patients and to study correlation of RDW and age of subjects.

METHODS

An observational cross-sectional comparative hospital-based study with 105 sample size conducted, at GCS medical college, hospital and research center, Ahmedabad for the duration of March 2017-March 2018 among patients presenting with acute HF with various etiology and healthy individuals. All patients aged above 18 years and diagnosed with of HF as per European society of cardiology criteria were included in the study.[10] Known cases of neoplastic metastasis to bone marrow, pregnancy, IBD, hypothyroidism, liver diseases, sideroblastic anemia, thalassemia, haemolytic anemia, CKD were excluded.

Sample size

The study of Rudresh et al observed that mean RDW in patient was 15.763±2.609 and in controls was 13.17±0.75.[9] Taking these values as reference and sample size ratio as 2:1, the minimum required sample size with 99% power of study and 1% level of significance is 20 controls and 40 cases. To reduce margin of error, we have taken 35 controls and 70 cases.

Populations divided in two groups, group A [cases]: HF patients as per inclusion criteria. Group B [controls]: Healthy subjects taken randomly from the OPD and wards without HF.

Data collection and analysis

The written informed consent was taken from all participants. Data were collected in semi structured Proforma. It includes all details, clinical history, blood investigation and other details of patients. Data were entered in MS excel sheet and analysed using SPSS software version 24. Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Quantitative variables were compared using Un-paired t-test (when the data sets were not normally distributed) between the two groups (with or without HF). Qualitative variables were compared using Chi-Square test. Pearson correlation coefficient/Spearman rank correlation coefficient was used to find out the correlation of RDW with age. A $p<0.05$ was considered statistically significant.

RESULTS

On gender-wise distribution of subcategory of HF cases, 38.5% males and 30% females suffering from HFREF, while 21.5% males and 10% females suffering from HFPEF (Table 1).

Table 1: Gender wise distribution of subcategory of HF cases, (n=70).

Sub category	Male (%)	Female (%)
HFREF	27 (38.5)	21 (30)
HFPEF	15(21.5)	7 (10)

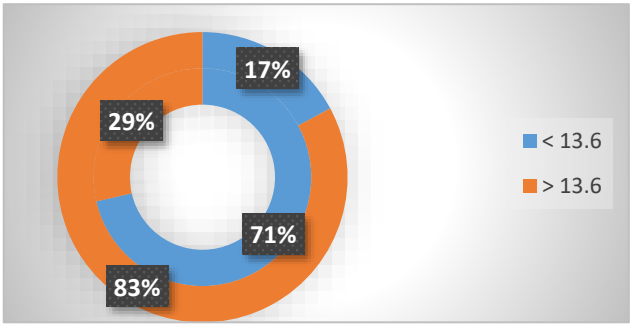

Figure 1: RDW distribution among case (n=70) and control (n=35).

Inner ring of chart represents RDW distribution among controls and outer ring of chart represent RDW distribution among cases (Figure 1).

Table 2: Comparison of RDW between cases and controls.

Group	RDW, n (%)		Chi square test (p)
	≤13.6	>13.6	
Control, (n=35)	25 (71.4)	10 (28.6)	30.13 (0.00001)
Case, (n=70)	12 (17.2)	58 (82.8)	

Among the cases and controls, 58 and 10 respectively were having RDW >13.6. There was significant association found between RDW of case and control group (Table 2).

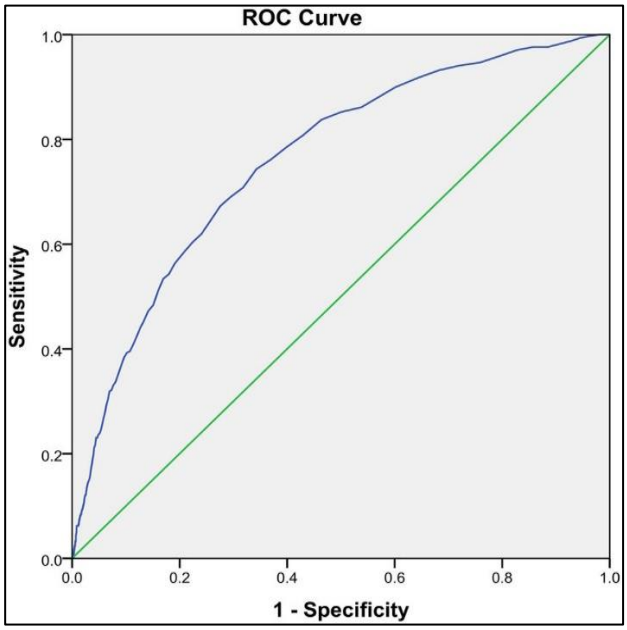

Figure 2: ROC curve of RDW distribution among HF cases, (n=70).

ROC curve, is a graphical plot that illustrates the diagnostic ability of a binary classifier system as its discrimination threshold is varied. RDW distribution is more sensitive indicator in acute HF (Figure 2).

DISCUSSION

The proposition of the study was "Red cell distribution width is associated with HF with reduced ejection fraction as well as HF with preserved ejection fraction at the time of presentation to hospital in comparison to normal population". Recently, RDW has been shown to be a unique marker for predicting outcomes in the HF population.[11-13] The cause of elevated RDW in HF patients has been attributed to inflammation, ineffective erythropoiesis, malnutrition, impaired renal function and neurohormonal activation.[14] The age of patients varied from 24 to 84 years, with a mean of 50.84 years. HF can occur in any age group. Most common rheumatic and non-ischemic cardiomyopathy involved younger age group whereas hypertensive heart disease and IHD involved older age group. The mean age of our cases were 54.2±1.33 years and controls were 49.6±2.4 years. It is similar to the study done by Celik et al.[15] Out of the 70 patients of HF, 28 were females and 42 were males. HF was more elaborate in males compared to females, so there was a male preponderance in the present study. This is in contrast to many other studies. Due to various pattern of admission in different hospital centres.[16] Converse findings was seen in study done by Celik et al 63% were women and the incidence of HFREF was more in males than in females. Their study is supported by in the meta-analysis global group in chronic HF (MAGGIC) study 2012 where the incidence of HFREF is more in males and HFPEF is more in females.[17]Among the study participants, 22 had IHD, 30 had hypertension, 30 had diabetes mellitus and remaining had other comorbidities like dyslipidaemia, etc. This inconsistent with the study by Al-Najjar et al where the aetiology of the HF was mostly IHD, hypertension and diabetes mellitus.[18] In India coronary artery disease, diabetes, hypertension and valvular heart diseases are the leading causes for HF. IHD is still a common cause of HF in India.[19] Present study was included all of the above aetiologies. Celik et al showed that RDW is elevated in patients of diastolic HF. In the current study has shown that RDW is elevated in patients of both systolic (HFREF) as well as diastolic HF population (HFPEF). RED width is a measure of variation in red blood cell size in a blood sample. It is calculated as part of the routine complete blood count. It is calculated as RDW=(SD of red cell volume/mean cell volume)×100. Higher RDW values mean a greater variety of cell sizes are present. The normal range for RDW is between 11.5 and 14.5%.[20]

Limitations

In present study small sample size was included so findings were not be generalized. RDW level was increased due to some hemopoietic diseases also.

CONCLUSION

The RDW is a rapid easily available hematological parameter, which is generated by all commercially available hematological analyzers together with the complete blood cells count (CBC). Increased RDW values in venous blood samples show degree of anisocytosis, and can hence be used for diagnostic and prognostic decisions in many acute and chronic pathological conditions including HF. Raised RDW can be used, in setting of HF, as cheap easily available marker for diagnoses when coupled with typical signs of HF in rural area where 2D echocardiography and other expensive serum biomarkers of HF such as NT ProBNP, ProBNP are not available.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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