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Original Research Article

Efficiency of Red Cell Distribution Width in Diagnosing Iron Deficiency Anemia

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Abstract

Background: The diagnosis of iron deficiency anemia (IDA) requires costly and sophisticated work up. Red cell distribution width (RDW), a marker of anisocytosis of RBC is altered in iron deficiency anemia.

Aim: To assess the utility of RDW for the diagnosis of IDA in microcytic hypochromic anemias.

Materials and Methods: Ninety three samples with microcytic anemia were analysed and classified into IDA and Non IDA groups based on serum ferritin. Hematological parameters including RDW were obtained from fully automated hematology analyser ADVIA 2120. Biochemical parameters were derived from COBAS E411 & Ranbox Imola. Receivers operating curve (ROC) was done to assess the sensitivity and specificity of RDW in diagnosis of IDA.

Results: In this study 45 samples were classified as IDA using serum ferritin as gold standard. ROC gave a cut of value of RDW at 19.8 with best sensitivity and specificity in diagnosing iron deficiency anemia. The sensitivity of RDW was 86.67% and specificity of 45.83%.

Conclusion: RDW has limited specificity and moderate sensitivity for diagnosing IDA in microcytic anemias.

Keywords: Red Cell Distribution Width; Iron Deficiency Anemia; Microcytosis.

Introduction

The most prevalent micronutrient deficiency in the world is iron deficiency anemia (IDA) [1]. The most common cause of IDA in developing countries like India is inadequate intake, poor bioavailability and excessive loss. IDA is defined as anemia with depleted iron stores with clinical features of compromised iron supply to the tissue by World Health Organisation (WHO) [2]. As IDA is easily treated, early diagnosis is effective. Red cell distribution width was proposed to be one of the sensitive indicators of microcytic hypochromic anemia [3]. Red cell distribution width (RDW) is a parameter for degree of anisocytosis of red blood cells (RBC) derived from automated hematology analyser. Efficient diagnostic approaches which can identify the diseases with accuracy by minimal tests, cost and good patient compliance are required. In the diagnosis of IDA, the bone marrow studies are invasive, serum ferritin, serum transferrin and serum iron are relatively of high cost, while RDW is derived as a part of routine blood counts using automated hematology analyser. If this can be used for screening IDA with acceptable accuracy, the cost of

work up would decrease considerably. There are several studies done regarding the utility of RDW in microcytic hypochromic anemias in children, while similar studies in adults are limited. Hence this study was conducted to test the efficiency of RDW as a cost effective marker in adults for IDA.

Aim

This study was carried out to assess the utility of RDW in iron deficiency anemia.

Materials and Methods

The present study was conducted in a tertiary care hospital to validate the role of RDW in diagnosing IDA by taking serum ferritin as gold standard. This study included 93 cases of anemia with microcytosis (Mean Cellular Volume <75 fl) during April 2015 to July 2015. 3ml of blood in plain tubes and 2ml in EDTA tubes collected from all the cases were subjected for complete blood picture and iron profile. They were classified as iron deficiency anemia and non iron deficiency anemia depending on serum ferritin levels (<11g/dl). Fully automated hematology analyser Siemens ADVIA 2120 was used for analysing hematological parameters including RDW. Serum ferritin was assessed by COBAS E411, iron and TIBC done by Ranbox Imola.

Inclusion Criteria

Cases with microcytosis and anemia were included

Exclusion Criteria

Cases with iron therapy, recent blood transfusion or malignancy were excluded.

Statistical Analysis

MedCalc statistical analysis was used in this study. Receiver operative curves were constructed for RDW and Mean Cellular Volume (MCV) in both iron deficient and non iron deficient groups to assess area under curve. The sensitivity and specificity of RDW and MCV were calculated.

Results

In the present study, out of 93 blood reports analysed, 45 samples (48.39%) were classified as iron deficient anemia by considering serum ferritin as gold standard. There was female preponderance in both the groups. The maximum age in IDA and Non IDA group was 80 years and 68 years respectively, while minimum age was 4 and 6 years. The age and sex distribution of both the groups is depicted in Table 1. There was marked difference in various biochemical and hematological markers in both the groups.

All the markers including MCV, Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), RDW and serum ferritin was higher in non iron deficient group. The hemoglobin levels were slightly higher in iron deficient group. The comparision of laboratory findings in both groups are depicted in Table 2.

Table 1: Age distribution of both IDA and Non IDA groups

Age / Sex	IDA group		Non IDA group		Total
	Male	Female	Male	Female	
1-10	2	0	1	0	03
11-20	0	5	0	6	11
21-30	2	12	1	5	20
31-40	3	11	6	11	31
41-50	0	2	0	7	09
51-60	2	2	1	4	09
61-70	1	1	6	0	08
71-80	2	0	0	0	02
Total	12	33	15	33	93

Table 2: Demographic and laboratory profile of IDA and Non IDA

Variable	Samples with IDA (45)	Samples with Non IDA (48)
Age in years	34.95	39.18
Sex M:F	1:2.75	1:2.2
Hemoglobin in g/dl	6.67	6.25
MCV in fl	63.26	77.43
MCH in pg	17.38	23.72
MCHC	27.22	30.04
RDW	18.29	19.62
Serum ferritin	5.51	228.92

ROC gave a cut of value of RDW at 19.8 with best sensitivity and specificity in diagnosing iron deficiency anemia. The sensitivity of RDW was 86.67%, specificity of 45.83% and area under curve of 60. The sensitivity and specificity of MCV were 55.78% and 84.42% respectively as shown in Table 3. The various cut off values of RDW with their specificity and sensitivity in diagnosing IDA is shown in Table 4.

Table 3: Sensitivity and specificity of RDW and MCV

Variable	Area under curve	Cut off value	Sensitivity (%)	Specificity (%)
RDW	0.600	<19.8%	86.67	45.83
MCV	0.766	<62 fl	57.78	85.42

Table 4: Sensitivity and specificity of RDW in diagnosing iron deficiency anemia

Cut off value of RDW in %	Sensitivity in %	Specificity in %
<16.7	20	77.08
<19.8	86.67	45.83
<20.9	93.33	31.25

Table 5: Comparison of sensitivity and specificity of RDW for IDA in various studies

Variables	Gold standard used	Cut off value RDW (%)	Sensitivity of RDW (%)	Specificity of RDW (%)
Present study	Serum ferritin, TIBC	19.8	86.67	45.83
Tejinder singh et al	Serum ferritin, TIBC	17.4	81	53
Sazawal etal	Serum ferritin or Zinc protoporphyrin	16.4	94.2	50.4
Flynn etal	Serum iron, TIBC, serum ferritin	13.4	94	51
Gupta et al	Serum iron, TIBC	17.1	61.3	92.5
Adelrahman et al	Serum ferritin	15	43.8	73.7

Discussion

The most prevalent anemia in developing countries is iron deficiency anemia. Hence, there is a need for a cost effective and reliable marker in diagnosing IDA. Many indicators like hemoglobin, hematocrit, serum ferritin, serum iron, total iron binding capacity, zinc protoporphyrin and erythropoietin were evaluated. However, some of these markers were costly, while others were less specific [4,5,6]. Iron deficiency produces RBC of smaller than the normal size leading to large size variation- anisocytosis and causes functional disturbances [7]. RDW, a parameter first described by Bessman and Feinstein was suggested for distinction between conditions associated with microcytosis [8]. This index reflects the heterogeneity in size distribution of erythrocytes measuring the coefficient of variation around MCV [9]. Hence we conducted this study to evaluate the efficiency of RDW for IDA

The parameters like MCV, MCH, MCHC, RDW were lower in IDA group than in non IDA group in the present study. This was similar to the studies conducted by Sazawal etal and Tejinder singh etal except for RDW which was higher in IDA group [10,12]. This disparity could be explained as the present study was done in adults, where microcytosis could be due to anemia of chronic disease.

This study mainly revealed moderate sensitivity (86.67%) and low specificity (43.85%) of RDW. This was in comparision with studies done by Tejinder singh et. al., Abdelreham etal and Sazawal et. al. [10,11,12]. The comparison of sensitivity and specificity of RDW with other authors is depicted in Table 5. The specificity (85.42%) and sensitivity (57.78%) of MCV in diagnosing IDA. MCV was more specific but less sensitive than RDW. Other approaches used to predict IDA are indexes like Mentzler's, discriminant function, Srivastava's, Shine and Lal's, MCV/MCH indices which are based on many hematological parameters instead of one [13]. In this study when two parameters like RDW and MCV were used together, there was considerable improvement in the sensitivity and specificity. These data suggest that combined approach of using RDW < 19.8% and MCV <62fl would improve the efficiency of diagnosing IDA, thus obivating the need for using expensive biochemical tests for IDA.

The limitaions of the study are presence of subclinical infections, latent inflammatory disorders and folic acid deficiency which can raise serum ferritin levels in our set up. The folic acid, vitamin B12 and hemoglobin electrophoresis were not done which could affect RDW. Anemia of chronic disorders could not be excluded by appropriate investigation. Hence we need to redefine the level of serum ferritin.

Conclusions

RDW alone has got limited specificity but when combined with MCV, there is noticeable improvement in both the sensitivity and specificity. Hence we recommend a combined approach of assessing both RDW and MCV for IDA. This would be simple, cost effective and easy method than costly and highly sophisticated assessment of serum ferritin.

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