Diagnostic Accuracy of Red Cell Distribution Width in Mild Iron Deficiency Anaemia in Women of Childbearing Age

Jamal Ahmad, Sehar Khaliq, . Lubna Zafar
Department of Pathology ,Foundation Medical College, Rawalpindi

Abstract

Background: **To determine the accuracy of red cell distribution width-coefficient of variation (RDW-CV) in detection of mild iron deficiency anaemia in women of child bearing age by comparing it with serum ferritin level.**

Methods: **In this cross-sectional study one hundred eighty women of child bearing age between 15-45 years with mild anaemia(Haemoglobin 9-11 g/dl) were selected. Complete blood count (including RDW-CV) was performed using automated haematology analyzer Sysmex XT 2000i. RDW-CVvalue of more than 17% was taken as cutoff. Those patients having RDW-CV>17% and a low serum ferritin < 15 ng/ml were taken as true positives while those with RDW-CV <17% and a high serum ferritin > 15 ng/ ml were taken as true negatives. False positives were those having a serum ferritin of > 15 ng/ml and RDW-CV of >17% while false negative were those having a serum ferritin of < 15 ng/ml and RDW of < 17%.**

Results: **Mean age of patients was 30± 4 years. Seventy (39%) patients were true positive while 65 (36%) patients were true negative. Sixty four patients (35.5%) were pregnant females and 116(64%) were non-pregnant females. Among the pregnant patients, 21 patients (32.8%) were true positive. Among non-pregnant females 69 patients (59.5%) were true positive.**

Conclusion: **RDW-CV has diagnostic significance as an early indicator of iron deficiency.**

Key Words: **Iron deficiency, RDW-CV, Anaemia**.

Introduction

Anaemia is a major health problem in developing countries especially effecting large proportion of women which contributes to high maternal morbidity and mortality and low birth weight of newborns.[1.]In Pakistan a high prevalence of anaemia in pregnant women is reported.[1]One regional study shows prevalence of anaemia among women of child bearing age in Pakistan to be 30%.[2]Iron deficiency is the commonest cause of anaemia in Pakistan.[3]

RDW-CV(coefficient of variation of red cell width)measures variability in size of red blood cells i.e. anisocytosis.[4]High RDW-CV along with low haemoglobin and low MCV is a predictor of iron deficiency anemia.[4] RDW-CV becomes deranged before reduction in haemoglobin and mean corpuscular volume so it helps in early detection of iron deficiency anemia.[4]At a cut off value of 17.4%, the sensitivity & specificity of RDW-CV in diagnosis of iron deficiency anaemia was found to be 81% and 53%.[5]At a cutoff level of less than 10.9 ug/l to diagnose iron deficiency anaemia, the sensitivity and specificity of serum ferritin was found to be 83% and 80% respectively.[6] In adults, serum ferritin below 15 ug/l is indicative of absence of storage iron.[7,8] RDW-CV is an inexpensive , quick, non invasive tool to predict iron deficiency anemia.[8]

Patients and Methods

A cross-sectional descriptive study was carried out in the Haematology department of Fauji Foundation Hospital Rawalpindi from August 2011 – August 2012.Consecutive sampling technique was used for sampling. Females in child bearing age (15−45)years of age with haemoglobin of 9−11 gm/dl and MCV <100 fl were included in the study. Those patients having red cell anomalies, acute diarrhea and other causes of reduced plasma volume, recent blood transfusion and iron therapy were excluded from the study. Selection bias was controlled by inclusion and exclusion criteria.Measurement technique bias was controlled by standardized lab tests.Venous blood 2.5 ml was collected in CP bottle containing EDTA(ethylene diamine tetra acetic acid) as anticoagulant.Complete blood counts(includes RDW-CV, Hemoglobin, and MCV) were analyzed on automated hematology analyzer Sysmex XT 2000i system. For serum ferritin 4 ml clotted blood was collected in plain test tube. Serum ferritin was performed on AXSYM system by immunoassay using AXSYM Ferritin reagent kit pack. Both the tests were verified by consultant pathologist. For iron deficiency a serum ferritin value of <15ng/ml was taken and a cutoff value of increased RDW is taken as >17%. Those

patients having RDW-CV >17% and a low serum ferritin of < 15% were taken as true positives while those with RDW-CV<17% and a serum ferritin of > 15% were labelled as true negatives. False positives were those having a serum ferritin of > 15ng/ml and RDW-CV of >17% while false negative were those having a serum ferritin of < 15ng/ml and RDW-CVof< 17%. Data was entered in software SPSS 17. Mean and standard deviation were calculated for quantitative variables i.e age of patient, Hb, RDW-CV% and serum ferritin. Frequency and percentage were calculated for qualitative variables i.e pregnancy status. Total number of true positive, true negative, false positive and false negative cases were calculated and sensitivity and specificity was determined using two by two tables.

Results

Out of a total of 180 females 64 (36%) were pregnant and 116 (64%) were non-pregnant . Mean RDW was 17.6% (Table 1)Those patients having RDW-CV >17% and a low serum ferritin were taken as true positives while those with RDW-CV <17% and low serum ferritin were labelled as true negatives. False positives were those having a serum ferritin of > 15ng/ml and RDW-CV of >17% while false negative were those having a serum ferritin of < 15ng/ml and RDW of < 17%. The total number of true positive cases were 70 (39%) while 65(36%) cases were true negative. Total number of false positive cases were 25 (13%) and 20 (11%) cases were false negative (Table 2). Sensitivity of RDW-CV for mild iron deficiency anaemia in women of child bearing age = 70/70 + 20 = 77%.Specificity of RDW-CV for mild iron deficiency anaemia in women of child bearing age= 65/65+25 = 72%

Table 1. RDW and correlation with serum ferritin

	Age (years)	Haemoglobin (g/dl)	RDW-CV%	Ferritin ng/ml
Mean	30± 4	10.5± 2	17.6 %± 3	9.0± 3
Standard Deviation	9.33	0.66	9.33	4.10

Table 2. RDW –sensitivity and specificity

Total no of positive and negative cases	Total patients	Total patients
Positive Test	True Positive (70)	False Positive(25)
Negative Test	False Negative (20)	True Negative (65)

Discussion

Various studies have been published which have assessed the accuracy of RDW-CV against serum ferritin in detection of iron deficiency anaemia. A study carried out in United States for early detection of iron deficiency showed raised RDW-CV to be 66% specific and 100% sensitive;and it was therefore concluded that RDW is the first parameter that becomes altered during development of iron deficiency.[9] In another study, the usefulness of RDW-CV,MCV and serum transferrin saturation in detection of iron deficiency anemia was evaluated in anemic hospitalized patients. The RDW of >15% had a sensitivity of 71% and a specificity of 54% for iron deficiency as measured by serum ferritin levels. The conclusion of this study is not in accordance with our study; the underlying reason being the study population in this group as it was an extended study and included all age groups and gender whereas in our study women of only child bearing age were selected.[10]

In another study, CBC and serum ferritin besides other tests for iron measurement were performed on pregnant females. RDW-CV was compared between iron deficient and non-iron deficient pregnant women. RDW-CV had sensitivity of 82.3%, specificity of 97.4% and accuracy of 88.4%. In our study, RDW-CV appears to be a very useful parameter for diagnosis of iron deficiency in non-pregnant females (accuracy of 70%) but less so in pregnant females (accuracy of 53%).[11]In another study, carried out on children aged between 6 months-12 years with microcytic (MCV <75 fl) anaemia were further grouped into iron deficient and non-iron deficient groups on the basis of serum ferritin and total iron binding capacity. At a cutoff value of 17.4% the sensitivity and specificity of RDW-CV in diagnosis of iron deficiency anaemia was 81% and 53% respectively with positive and negative predictive value of 63% and 72% respectively.[12]

A study in Pakistan was conducted in Karachi on patients aged 3 months – 55yrs, who were referred for haemoglobin electrophoresis. On complete blood counts, 200(67%) patients had hypochromic /microcytic anaemia. 82(41%) patients had thalassaemia minor on haemoglobin electrophoresis. 118(59%) patients had hypochromic microcytic anaemia. 110(94%)of the non thalassaemic patients with microcytic hypochromic anaemia had elevated RDW-CV of >23%. Of 82 thalassemics, 6 had elevated RDW-CV. Among thalasaemics 28 had normal haemoglobin. Among 54 patients with anaemia, 35 patients had elevated RDW. The results suggested that

RDW-CV alone cannot be used to distinguish reliably between iron deficiency and other causes of microcytosis.[13] Our study suggests that RDW-CV can be used as a reasonably reliable indicator of iron status in females of child bearing age especially in non-pregnant women as it is moderately sensitive to iron deficiency in comparison to serum ferritin. It also has shown itself as an early indicator of iron deficiency in about a quarter of the patients, when MCV is still normal. Other regional and international studies have found more or less similar results with limited accuracy and specificity of RDW-CV for iron deficiency but it has shown good sensitivity for iron deficiency. Thus RDW-CV can be a reasonably good early indicator of iron deficiency and can be used as a screening test to detect iron deficiency in patients especially females of child bearing age, having mild anemia. Complete blood count (including RDW-CV) is a much cheaper test than serum ferritin and thus can be very useful in OPDS and antenatal clinics besides other departments, especially in setups with low resources and heavy patient burden.

Conclusion

RDW-CV as part of complete blood count can be used in females of child bearing age as a screening test for iron deficiency as it is simple, cost effective, and noninvasive and is associated with good sensitivity.

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