Original Article

Red Cell Distribution Width is Early Marker for Detection of Iron Deficiency Anemia during Pregnancy

Bibi Sarah, Khalida Sheikh, Tazeen Shah

ABSTRACT

OBJECTIVES: To estimate the frequency of iron deficiency anemia in pregnancy and to analyzed the diagnostic value of RDW and compared it with non-anemic pregnant women.

METHODOLOGY: Descriptive / observational study at LUH Hospital Hyderabad, Sindh from April to October 2015. Total two hundred pregnant women were selected from which 100 non- anemic pregnant women as a control and 100 anemic pregnant women as experimental group were selected. Subjects were selected through non-probability purposive sampling. Blood samples were collected in bottles containing EDTA as an anticoagulant for complete blood counts. Serum iron and ferritin levels were measured. Data were analyzed using SPSS v.16. Chi Square & Student t-test applied.

RESULTS: Mean±SD RDW in anemic and non-anemic pregnant women was noted as 12.83±1.03% and 17.32±3.42% respectively with highly significant p-value of 0.0001. Anemia was noted in (87%) from 100 pregnant women, and the RDW was found raised in 83% women with raised RDW, 73 women showed iron deficiency anemia, RDW showed excellent sensitivity and specificity of 92% and 84.7% respectively.

CONCLUSION: The present study reports iron deficiency in pregnant women. Raised RDW was noted in iron deficiency anemia of pregnancy. RDW showed 92% sensitivity and 84.7% specificity for predicting iron deficiency anemia of pregnancy; hence it may prove of diagnostic and predictive value in clinical practice. It is concluded that the RDW is inexpensive compared to iron profile testing, hence it may be used as initial screening tools in iron deficiency of pregnancy.

KEY WORDS: Red cells distribution width, Pregnancy, Anemia

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INTRODUCTION

The hemoglobin concentration and low hemoglobin within red blood cells are the most widely identified hematological abnormality[1] and associated with adverse pregnancy outcome[2]. During 8-10 week of gestation the red blood cell mass begins to increase 20-30% (250–450 ml) as compared to non pregnant ladies so the need of iron increases.

In normal pregnancy the erythropoietin levels increase by 50% and levels may fluctuate during complicated pregnancy. Increases levels of erythroprotein enhance the red cell mass which to some extent supports the higher metabolic requirement for oxygen[3]. A cut off value of 30-70 mm first hour reading (FHR) for erythrocyte sedimentation rate in normal pregnancy[4].

Anemia is most common disorder during pregnancy and it is defined as hemoglobin <10.5 g/dl in pregnancy[3]. Its prevalence, etiology and its severity varies among different populations. The prevalence of iron deficiency anemia, (IDA) is 35% for non-pregnant women and 51% for pregnant women world wide[5]. In developed countries the anemia in pregnancy is about 18% whereas 35-75% is found with an average of 56% in developing countries[6,7].

Anemia during pregnancy has been reported to be associated with cardiac failure, hemorrhage, infection, pre-eclampsia leading to death of pregnant women. Its effect on new born include intra-uterine growth retardation, low birth weight, anemia and increases the morbidity and mortality[5,6]. New Factor of RDW is assessed by hematology for measurement of CBC count. RDW gives us a sign of early changes in RBCs, associated with IDA. Hence, the CBC can be utilized as a simple and rather cheap test to identify IDA through the RDW[8]. RDW can detect changes and small variations in red cell among different populations[9].

An arithmetic measure of the changeability in the size of circulating erythrocytes, estimated throughout a typical complete blood count, is termed as RDW[10]. Usually, red blood cells have typical size, but disorders cause erythropoiesis or increased damage cause larger heterogeneity in size and a higher

RDW[16]. It can be used as a indicator of bone marrow dysfunction, inflammation or nutritional deficiencies, or may characterize an event of the pathological process[12]. Red cell distribution width (RDW) is a marker for deregulated erythropoiesis and is elevated in microcytic hypochromic anemia, macrocytic anemia, and myelodysplasias[13].

The present study is proposed to analyze the role of RDW in diagnosing IDA in pregnancy, and to present facts on RDW in anemia of pregnancy as a simple inexpensive diagnostic tool.

METHODOLOGY

Descriptive / observational study with Purposive (Non Probability) sampling technique at the Department of Physiology in collaboration with Department of Obstetrics and Gynecology, Unit III, and Diagnostic and Research Lab, Liaquat University Medical and Health Sciences Hospital Jamshoro/Hyderabad, Sindh from April to October 2015. Total two hundred pregnant women were selected from which 100 non-anemic pregnant women as a control and 100 anemic pregnant women as experimental group were selected. Subjects were selected through non-probability purposive sampling. Blood samples were collected in bottles containing EDTA as an anticoagulant for complete blood counts. Serum iron and ferritin levels were measured. Data were analyzed using SPSS v.16, using student's t-test and Chi-square test were applied and p value of ≤ 0.05 was taken as statistically significant.

Inclusion criteria: Pregnant women Anemic /non-anemic (>28 weeks of gestation), Age limit 25-50 years. Exclusion criteria: Twin babies, Diabetes mellitus, Systemic hypertension, pulmonary tuberculosis, Pregnancy induce hypertension, HELLP syndrome (hemolysis elevated liver enzymes low platelet count), and other systemic problems.

DATA COLLECTION PROCEDURE

A detailed patient history regarding duration, and symptoms related to the pregnancy was noted. The data was collected on a structured proforma. Following laboratory investigations were performed.

COMPLETE BLOOD COUNT (CBC)

5ml of blood samples was collected from each participant by venipuncture and transfer in EDTA containing test tubes as an anticoagulant and were processed on automatic hematoanalyzer, Sysmex Xn-1000. The following blood indices and parameters were studied in detail. Hematocrit (%), hemoglobin (gm/dL), RBC(million/uL), MCHC (Mean corpuscular hemoglobin concentration as %), MCH (Mean corpuscular hemoglobin as pg/dl), MCV (Mean corpuscular volume as femtoliter), and Red cell Distribution width (%).

MEASUREMENT OF IRON PROFILE AND FERRITIN

The blood was collected & stored in a clean plain bottle. Analysis for the serum iron & TIBC was done on COBAS 600. The serum ferritin levels were measured by COBAS e 411.

DATA ANALYSIS:

SPSS version 16 was used for data analysis. The quantitative variables were analyzed as mean±SD (age, RBC, counts, etc) using student's t-test. Frequency and % were presented for variables using Chi-square test. A p-value ≤ 0.05 was taken as statistically significant.

RESULTS

Total 200 pregnant women included in this study and divided into two groups. 100 non- anemic pregnant women as a control and 100 were anemic pregnant women as experimental group were selected. The age of control group was noted as 26.53±1.85 years while as compared to the cases subjects were 35.39±7.28 years. Hemoglobin was 11.82±1.03 g/dl in control subjects while as compared to cases subjects it was 7.67±1.46 g/dl. RBC counts, hematocrit, MCV, MCH, MCHC and red blood cell distribution width (RDW) are shown in table 1. All of above variable showed significant difference (p<0.05).

Serum iron, total iron binding capacity (TIBC) and serum ferritin in subjects with normal Hb and anemia were noted as 111.84±35.73 vs. 63.05±32.94 µg/dl, 292.30±47.82 vs. 482.58±130.57 µg/dl and 46.12±22.30 vs. 38.57±17.47 ng/dl respectively. Normal Fe, TIBC and ferritin were noted in 27%, 32% and 30% of subjects respectively. Low Fe, high TIBC and low ferritin were noted in 73%, 68% and 70% subjects respectively. Iron, TIBC and ferritin are sown in table 2 and graphs 2 respectively.

RED BLOOD CELL DISTRIBUTION WIDTH (RDW)

Mean±SD RDW in normal and anemic subjects was noted as 12.83±1.03 and 17.32±3.42% respectively (p=0.0001) (table 1), of 87 anemic pregnant women, the RDW was elevated in 83, of which 73 subjects showed severe iron deficiency. RDW presented specificity of 92% and 84.7% respectively.

Linear regression analysis model of RDW and serum iron is shown in table 3. Coefficient was found as 19.98, this indicates the cut point indication for the iron deficiency. Scatter plot shows in graph 3 the linear regression analysis of RDW as dependent variable for prediction of iron deficiency anemia.

TABLE I:
AGE, HEMOGLOBIN, HEMATOCRIT, RBC COUNTS AND RBC INDICES OF STUDY POPULATION

Variables	Group A	Group B	t-value	p-value
	Mean± SD	Mean± SD		
Age (years)	26.53±1.85	35.39±7.28	13.6	0.001
Hemoglobin (g/dl)	11.82±1.03	7.67±1.46	19.83	0.0001
Hematocrit(%)	40.04±2.15	31.94±3.28	18.59	0.0001
RBC counts ($x10^6$)	3.69±0.50	3.05±0.55	14.35	0.01
MCV (fl)	94.84±13.48	62.49±12.45	15.59	0.001
MCH (pg/dl)	32.46±2.36	23.01±3.61	21.45	0.0001
MCHC (%)	33.30±1.84	22.85±4.05	33.15	0.0001
RDW (%)	12.83±1.03	17.32±3.42	60.75	0.0001

GRAPH I:
AGE, HEMOGLOBIN, HEMATOCRIT, RBC COUNTS AND RBC INDICES OF STUDY POPULATION

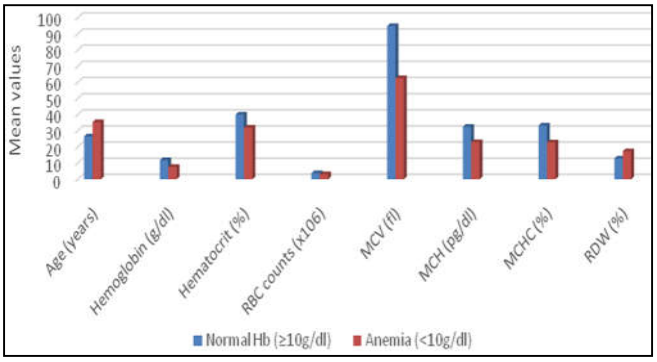


TABLE II: SERUM IRON, TOTAL IRON BINDING CAPACITY (TIBC) AND SERUM FERRITIN IN STUDY SUBJECTS

Variables	Group A	Group B	t- value	p-value
	Mean ± SD	Mean ± SD		
Iron (Fe) (µg/dl)	111.84±35.73	63.05±32.94	48.0	0.0001
TIBC(µg/dl)	292.3 ±47.82	482.58±130.75	20.84	0.0001
Ferritin (ng/dl)	46.12 ±22.30	38.57±47.47	34.0	0.035

GRAPH II: SERUM IRON, TOTAL IRON BINDING CAPACITY (TIBC) AND SERUM FERRITIN IN STUDY SUBJECTS

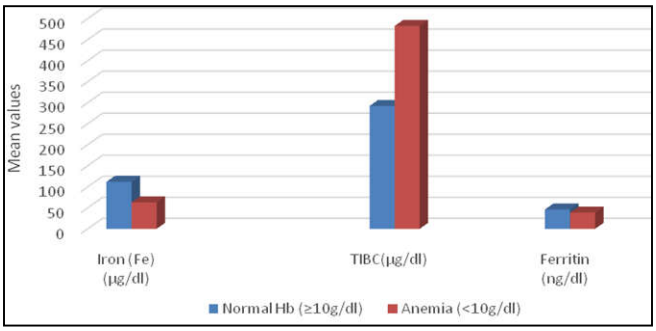
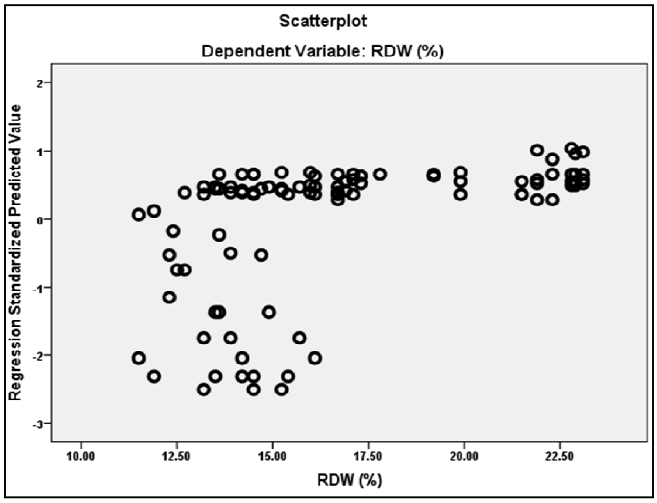


TABLE III: ANALYSIS OF VARIANCE (ANOVA)[a]

Model		Sum of Squares	Df	Mean Square	F	p-value
1	Regression	295.86	1	295.86	30.44	0.0001[b]
	Residual	952.33	98	9.71		
	Total	1248.20	99			

a. Dependent Variable: RDW (%)
b. Predictors: (Constant), Fe (µg/dl)

GRAPH III: SCATTER PLOT SHOWING DISTRIBUTION OF RDW AS DEPENDENT VARIABLE IN IRON DEFICIENCY ANEMIA



DISCUSSION

The present study was conducted in Hyderabad, Sindh which determined the RDW in iron deficiency anemia of pregnancy and its predictive value. IDA is one of the commonest nutritional problems. About 30-70% population of developing countries is suffering from the nutritional problems[1,15].

In present study, the RDW was found elevated in IDA of Pregnancy. The mean±SD RDW in normal and anemic subjects was noted as 12.83±1.03 and 17.32±3.42% respectively (p=0.0001). Of 100 experimental subjects, 83% showed a high RDW while 17% showed normal RDW. A negative linear association was observed between RDW and serum iron levels. Out of 87 anemic pregnant women, the RDW was elevated in 83, of which 73 subjects showed severe iron deficiency.

In present study, the RDW showed a sensitivity and specificity of 92% and 84.7% respectively for iron deficiency at cut off point of 19.98% in linear regression model. Above findings are in full comparison study reported by Abdelrahman EG 2012[18] evaluated 100 anemic patients, and reported sensitivity of 92.1%

and specificity of 90.9% for RDW in detecting iron deficiency.

Another study from Bangladesh Sultana GS 2011[6] has reported sensitivity and specificity of 61.3 and 92.5 respectively (p<0.0001) for RDW in iron deficiency anemia. Our finding of specificity is a comparable finding to above study; however, the sensitivity of 61.3 reported by Al-Farsi SH 2014[4] is in contrast to present study had reported 81.0% and 53.4% sensitivity and specificity respectively at an RDW cut-off value of 17.4% for predicting microcytic hypochromic anemia. Finding of sensitivity of above study is close to our findings but the specificity is in full contradistinction to present and previous studies[16-18]. In present study the RBC indices were counted. MCV as normal, low and high was noted in 17, 79 and 4% of subjects respectively (p=0.0001). This shows elevated MCV was also noted in 4 cases. Normal, low and high MCH and MCHC were noted as 18%, 79% and 3% respectively (p=0.0001).

Our findings of RBC indices the MCV, MCH and MCHC are in comparison to Matos JF 2015[14]. has suggested diagnostic utility of RDW for distinction between microcytosis of IDA and thalassemia. Sahli CA et al[12] reported that the RDW was elevated in thalassemia minor and IDA patients.

A previous study from south Ethiopia Kefiyalew F 2014[15] concluded that the RDW, as alone, cannot discriminate correctly microcytic hypochromic anemia of iron deficiency and other causes. However, elevated RDW of above study is in favor of our present study. Besides this study, Matos JF 2015[14] reported of RDW as of no diagnostic value in differentiating various causes of microcytic anemias.

A previous study of Abdelrahman EG 2012[18] has reported on the presentation of RDW in the diagnosis of IDA and he was also using serum ferritin as a gold standard. The specificity and positive or negative predictive value of RDW was reported as 43.8%, 73.7%, 41.0%, and 76.0% respectively. Another study, conducted on pregnant women, showed RDW (cut off value ≥15%) revealed sensitivity and specificity of 46.8% and 95.7% respectively[19]. Specificity of 95.7 of above study is a comparable finding to our present study.

Avcioglu SN 2015[20] studied 102 pregnant women with pre-eclampsia and 98 pregnant women without preeclampsia as controls. Red blood cell indices the MCV, MCH, MCHC and RDW were determined. The RDW in pre-eclampsia was found to be very high - median 15% (range 13.8-17.45%) compared to controls – median 13.9% (range 13-15.6%) (p<0.01). We are of opinion that the RDW, although non-specific, but is found elevated in IDA of different types such as pregnancy and is supported by previous studies as discussed above.

The confines of the present study are small sample size and falsely raised serum ferritin as pregnant women might be suffering from subclinical infections which might yield false results. RDW was not differentiated in various trimesters of pregnancy and values for local population are non-existent. Microcytic anemia of other causes such as thalassemia minor were not screened which is very common entity in our population.

Our present study does show in the good light of likelihood findings that the RDW may prove helpful as a initial screening tool, if not diagnostic, it may guide to proper work up for Iron deficiency of pregnancy in poor population which cannot afford expensive investigations.

CONCLUSION

The present study reports an elevated sensitivity (92%) and specificity (84.7%) of RDW for prediction of iron deficiency anemia. In the present study P value is <0.001, which is strongly significant. So iron deficiency anemia does affect RDW and it can predict the iron deficiency anemia.

REDCOMMENDATIONS

Further studies are recommended to confirm the findings of our present study, if RDW becomes the proven as screening marker of iron deficiency anemia; this will benefit the poor subjects of the country. Also reference values of local population need to be settled as currently we are using western countries reference values which may not be authentic for indigenous population of the country.

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