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Comparison Between Red Cell Distribution Width And Red Cell Indices In Prediction Of Anaemia Among Pregnant Women

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Abstract

Introduction: Anemia in pregnant women is an important cause for maternal mortality and is also associated with poor perinatal outcomes. Early detection and prompt management of anemia in pregnancy can lead to substantial decrease in maternal and perinatal mortality and morbidity. Efficient diagnostic approaches are necessary in order to achieve the same. Based on this aim of our study is to determine and compare the usefulness of red cell distribution width and red cell indices in prediction of anemia in pregnant women and also to determine the morphological types of anemia in pregnancy.

Materials And Methods: This study was done as a prospective Cross-sectional study, in Department of Pathology, Velammal Medical college hospital & Research centre for period of 6 months. Pregnant women attending the out-patient department or admitted to in-patient Obstetrics and Gynecology wards who are referred to the laboratory, Pathology department at Velammal medical college hospital to be included in this study. The various study parameters were obtained from an automated hematology analyzer. A peripheral smear was prepared from the same sample and visually examined for morphological typing of anemia.

Results: There was statistically significant relationship with changes in values of red cell distribution width, mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration with change in level of hemoglobin. This correlation was more significant with change in value of red cell distribution width compared to red cell indices.

Conclusion: Red cell distribution width and red cell indices are cost effective and simple methods which can be used as screening tools for iron deficiency anemia in pregnancy.

Keywords: Anaemia, pregnancy, red cell distribution width

Introduction

Anemia is an important nutritional problem affecting all segments of the population in general and children, women and pregnant women in particular. It continues to be the most important single cause of maternal mortality and also in fact for abnormalities such as premature births, still births and neonatal mortality.[1]

The importance of anemia as a major public health problem throughout the world is widely recognized.

According to the World Health Organization (WHO), in India the prevalence of anemia among pregnant women averages 49.7%.[1] Various studies from different regions of India have reported the prevalence of anemia among pregnant women to be around 50%.[2] The single most important cause for anemia among pregnant women in India is iron deficiency due to inadequate dietary intake of iron.

Red cell distribution width (RDW), which is a quantitative measure for red cell size variation (anisocytosis) and mean corpuscular volume (MCV), which is the average volume of red cells, are predictors of iron deficiency anemia (IDA).

In the era of rising cost consciousness, efficient diagnostic approaches, which can rule in or rule out diseases with sufficient accuracy so that testing is minimized, are particularly welcome. Bone marrow studies are invasive methods and serum ferritin, serum transferrin, and serum iron are relatively expensive while red cell distribution width and red cell indices are part of routine blood counts in laboratories using automated hematology analyzers. The automated facility is cost effective and time saving, contrary to the tedious time consuming visual estimation of red blood cell size showing limitations of significant subjectivity associated with visual inspection.[3]

Various previous studies[3-5] have debated the role of RDW and MCV in prediction of anemia. In the present study, comparison between RDW and MCV, along with other red cell indices, will be done to determine which amongst them is a more accurate predictor of anemia in pregnant women.

The usefulness of red cell indices and red cell analyzer parameters including RDW and MCV in the prediction and differential diagnosis of anaemias has been studied by several authors.[3-5]

Khan H *et al* [4]studied the role of RDW and red cell indices in prediction of anemia among 152 pregnant women and found that the rise in RDW in the last trimester of pregnancy and near delivery was more significant than changes in MCV for the diagnosis of anemia. They concluded that RDW was the best indicator for prediction of anemia in pregnancy but should be correlated with other red blood cell indices to make the findings more reliable and confirmatory.

Sultana GS *et al* [5] studied the role of RDW in the detection of anemia in pregnancy within the first 20 weeks of gestation. With a sample size of 190 pregnant women, they found that RDW had sensitivity of 82.3% and specificity of 97.4% whereas hemoglobin level, MCV, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and peripheral blood smear had 56.6%, 29.2%, 68.1%, 15% and 38.9% sensitivity with 90.9%, 98.7%, 83.1%, 96.1% and 98.7% specificity respectively. They concluded that RDW appeared to be a reliable and useful parameter for detection of anemia during pregnancy.

Aulakh R *et al* [3] studied the usefulness of RDW in the diagnosis of iron deficiency with microcytic hypochromic anemia in children. They reported that RDW had limited specificity in diagnosis of iron deficiency anemia among children and suggested that further studies were necessary in a systemic manner to make an accurate diagnosis of the cause of microcytosis.

Simel DL *et al* [6] compared red blood cell anisocytosis on visual inspection of blood films with automated analysis of RDW. They noted that visual examination of peripheral blood film allows semi-quantitative description of anisocytosis while quantitative measures can be determined from automated hematology analyzers. They suggested that the extreme precision of RDW should make it the gold standard for measuring anisocytosis. Based on this aim of our study is to determine and compare the usefulness of red cell distribution width and red cell indices in prediction of anemia in pregnant women and also to determine the morphological types of anemia in pregnancy.

Material and Methods

This study was done as a prospective Cross-sectional study, in Department of Pathology, Velammal Medical college hospital & Research centre for period of 6 months. Pregnant women attending the out-patient department or admitted to in-patient Obstetrics and Gynecology wards who are referred to the laboratory, Pathology department at Velammal medical college hospital to be included in this study.

Considering the prevalence of anemia in pregnant women in India as 49% and taking 95% confidence interval and at 15% allowable error the calculated

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sample size is 180, using the statistical formula, the calculated sample size is 180.

All the blood samples of the pregnant women attending antenatal OPD or admitted to in-patient Obstetrics and Gynecology ward which will refer to laboratory, pathology department at velammal medical college irrespective of parity and previous obstetric history.

Pregnant women with gynecological disorders like tumors of the female genital tract, fibroids, or other associated disorders, who had received parenteral iron supplementation, who had received blood transfusion within the last 3 months and with bleeding disorders were excluded.

Under aseptic precautions, venous blood samples will be collected from pregnant women who fulfill the eligibility criteria after taking informed consent. A detailed history of the included pregnant women will be elicited.

Two milliliters of blood will be collected using BD Eclipse™ safety needles 22G and ethylene diamine tetra acetic acid vacutainer (BD Vacutainer® K2 EDTA 2 ML) and immediately analyzed for a complete haemogram, including hemoglobin, red blood cell (RBC) count, and RDW, using an automated hematology analyzer Beckman Coulter LH750 and LH780. A peripheral smear will be prepared from the same sample and visually examined for morphological typing of anemia. Haemoglobin level of less than 11.0 g/dl will be considered for diagnosis of anemia in pregnant women.

Statistical Analysis:

Data will be analyzed using following statistical methods: Sensitivity, Specificity, Positive predictive value, Negative predictive value, Chi square test, and other method, if required

Results

A total of 180 pregnant women with anemia were included in this study. The observations and results of the study are as follows. The majority of the pregnant women, 143(79%), in the study were in the age group of 21-30 years. 11 (6%) were less than 20 years of age, and 26 (15%) were older than 30 years of age. 90 (50%) women were primigravida. 58 (32%) women were gravida two, 28 (15.5%) were gravida three, 3 (1.5%) were gravida four, and 1 (1%) were gravida five or more.

In our study 43 (24%) pregnant women had mild anemia, 23 (12.5%) had moderate anemia, and 1 (0.5%) had severe anemia.

Table 1: Degree of severity of anemia

Degree of anaemia	No. of cases	Percent (%)
Severe	1	0.5%
Moderate	23	12.5%
Mild	43	24%
Normal	113	63%
Total	180	100%

The morphological type of anemia was determined on the basis of the peripheral smear examination. 75 cases (41%) had microcytic hypochromic type of anemia, 58 cases (32%) had normocytic normochromic anemia, 27 cases (15%) had dimorphic anemia, 21 cases (10%) had normocytic hypochromic anemia, and 4 cases (2 %) had macrocytic anemia.

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In the present study, the age of the study population ranged from 18 years to 38 years with a mean of 25.2 years (SD = 3.9). The Hb level ranged from 2.1 g/dl to 13.8 g/dl, with a mean value of 8.9 g/dl (SD = 1.5). The RDW ranged from 11.2% to 30.8%. The mean value of RDW was 19.1% (SD = 3.5). The MCV ranged from 30.4 fl to 101 fl, with a mean value of 82.3 fl (SD = 9.5). The MCH ranged from 17 pg to 34.1 pg, with a mean value of 22.1 pg (SD = 4.1). The MCHC ranged from 31 g/dL to 38.8 g/dL, with a mean value of 33.2 g/dL (SD = 2.1). The RBC count ranged from 0.7 million/cu mm to 5.47 million/cu mm. The mean value of RBC count was 3.2 million/cu mm (SD = 0.9). The value of Hct ranged from 6.2% to 46 %, with a mean value of 29.6% (SD = 4.5).

Table 2:

Parameters	**Degree of anemia**	**No. of cases**	**Mean**	**SD**	**ANOVA**
					p value
RDW	Severe	1	24.1	0	<0.001*
	Moderate	23	17.93	4.6	
	Mild	43	17.34	4.02	
	Normal	113	15.13	2.45	
HCT	Severe	1	6.2	0	<0.001*
	Moderate	23	28.65	1.63	
	Mild	43	31.78	1.11	
	Normal	113	35.74	2.55	
RBC	Severe	1	0.7	0	<0.001*
	Moderate	23	3.66	0.4	
	Mild	43	3.81	0.52	
	Normal	113	4.11	0.35	
MCV	Severe	1	68.34	0	<0.001*
	Moderate	23	78.91	8.98	
	Mild	43	83.24	8.27	
	Normal	113	91.5	8.75	
MCH	Severe	1	23.2	0	<0.001*
	Moderate	23	25.77	3.54	
	Mild	43	27.81	2.82	
	Normal	113	29.02	2.11	
MCHC	Severe	1	31.2	0	<0.001*
	Moderate	23	32.55	0.76	
	Mild	43	33.13	0.71	
	Normal	113	33.41	0.79	

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Comparison of the mean values of study parameters with the degree of anemia was done to determine their significance. It was found that there was significant correlation between changes in RDW (p value <0.001), MCH (p value <0.001), and MCHC (p value <0.001) with the degree of anemia. The change in MCV (p value < 0.001) did not correlate with the degree of anemia.

Table 3:

HB%	**R VALUE**	**P VALUE**
RBC	0.03	0.124
HCT	0.073	0.329
MCV	0.027	0.026
MCH	0.154	0.039
MCHC	0.149	0.045
RDW	-0.07	< 0.001

There is significant inverse correlation (r = -0.07) between change in the value of RDW and Hb level. The change in value of MCV significantly correlate with the Hb level (r = 0.027). Also there is significant correlation (r = 0.154) between change in the value of MCH and Hb level. There is significant correlation (r = 0.149) between change in the value of MCHC and Hb level.

Discussion

This study was done as a prospective Cross-sectional study, in Department of Pathology, Velammal Medical college hospital & Research centre for period of 6 months in 180 patients. The observations were compiled, results statistically analyzed, and discussed in comparison with previous studies.

The majority of the patients in the study were young females, in the age group of 21 to 30 years. Few study subjects were younger than 20 years of age. The analysis of the gravida and parity status of the young females showed that the current pregnancy was, in majority of the cases, the first, closely followed by second.

This highlights the fact that, although there is awareness about family planning in the general population, it needs to be fortified in order to avoid pregnancies at a very young age. The fact that most of the study subjects were in the third trimester of pregnancy is due to the preference given to pregnant women who were admitted to the labor room for delivery as they were on the verge of delivery and their Hb levels would be a better reflection on the overall health condition throughout pregnancy.

Degree Of Anemia:

Analysis of the degree of anemia among the study subjects showed that most of the pregnant women had either moderate (7.0 g/dl to 9.9 g/dl) or mild (10.0 g/dl to 10.9 g/dl) degree of anemia, with only 26 cases (14.4%) showing severe anemia (< 7.0 g/dl). Noronha et al[2], in their study on prevalence of anemia in pregnant women in Udupi district, found that 63.5% pregnant women had mild degree of anemia, 35.0% had moderate degree of anemia, and only 1.5% had severe degree of anemia. A study conducted by Viveki et al[7] found that majority (50.4%) of the pregnant women had moderate degree of anaemia, 42.6% had mild degree of anemia, and 7.0% had severe degree of anemia. In a study of similar parameters, Arifulla et al[8] found that 70% of the pregnant women had moderate degree of anemia, 18% had mild degree of anemia, and 12% had severe degree of anemia. These findings are consistent with our study.

Subgroup analysis revealed that values of RDW, MCH and MCHC changed significantly in pregnant women with severe degree of anemia when compared to the pregnant women with moderate and mild

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degree of anemia. However, the change in value of MCH was not significant in this regard.

Type Of Anemia:

In our study 41% of the pregnant women in our study had microcytic hypochromic type of anemia, which is the most common morphological form of anemia seen in cases of iron deficiency.[3] This is consistent with the findings of Arifulla et al[8], who observed that microcytic hypochromic anemia comprised 70% of their study cases, macrocytic anemia were 17% and dimorphic anemia were 13%. The occurrence of normocytic hypochromic type and normocytic normochromic types of anemia can be attributed to oral iron supplementation prescribed to pregnant women as a part of routine antenatal care.[9]

Red Cell Parameters:

The main objective of our study was to determine and compare the usefulness of red cell distribution width and red cell indices in prediction of anemia in pregnant women. The value of RDW had an inverse relationship with change in Hb level. A decrease in the Hb level was associated with a corresponding increase in the value of RDW. This had a good correlation and was found to be statistically significant.

The value of MCV showed a decrease with decrease in the Hb level. This showed a weaker correlation with the level of Hb and was found to be statistically insignificant. The values MCH and MCHC showed correlation with change in level of Hb. There was a corresponding decrease in the values of MCH and MCHC associated with decrease in Hb level. The correlation between these two parameters and change in Hb level was found to be statistically significant.

These findings are consistent with those of Sultana et al[10], who had concluded that red cell distribution width appeared to be a reliable and useful parameter for detection of iron deficiency during pregnancy. In their study, RDW was found to be the best parameter for prediction of IDA among pregnant women.

Similar results were obtained by Lin et al[11] who found that low MCV and high RDW were the characteristic changes of IDA in pregnancy and recommended the use of RDW and MCV in the initial classification of anaemia in pregnancy. The findings of Khan et al[12] matched with our study. They had found that increase in RDW (36.2% of cases) was more sensitive than decrease in MCV (19% of cases) for prediction of IDA. Our findings match with those of McClure et al[13], who found than an increased RDW was 66% specific and 100% sensitive for the diagnosis of IDA. Similar results were also obtained by Casanova et al[14].

However, a study by Aulukh et al[4] had contradictory results. They found that, with sensitivity and specificity of 81.0% and 53.4% and a positive and negative predictive value of 63.0% and 72.2% respectively, RDW had a limited specificity in the diagnosis of IDA.

There can be significant reduction in the complications associated with anemia in pregnancy if there is early detection and prompt management. There can be substantial reduction in under nutrition in childhood, adolescence, and improvement in adult height.

In the current scenario, with a high prevalence rate of anemia in pregnancy and in a system where health care services are burdened with high work load, it is necessary to make the diagnosis with minimum laboratory tests. An early diagnosis will lead to formation of better management strategies, eventually reducing the burden on health care services. RDW and red cell indices, which are part of routine hematological parameters in laboratories using automated hematology analyzers, can be helpful in early diagnosis of anemia in pregnancy.

Conclusion

Red cell distribution width is the best indicator for prediction of iron deficiency anemia in pregnancy. The rise in the value of red cell distribution width correlates more significantly than changes in mean corpuscular volume with change in level of hemoglobin in pregnancy. Red cell distribution width must be correlated with other red blood cell indices to make the findings more reliable and confirmatory. It is recommended to use red cell distribution width and mean corpuscular volume in the antenatal care centers for early diagnosis of anemia in pregnant women.

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