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Evaluation of Iron Deficiency Anaemia in Pregnant Females and Correlation of Red Cell Indices with Serum Ferritin

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Abstract
Background: *Iron deficiency anaemia is the main cause of the anaemia throughout the world especially in women of reproductive age group and particularly during pregnancy. Various parameters that are used to evaluate the cause of anaemia include complete blood cell count, peripheral smear, reticulocyte count, serum iron indices.*
Methods: *This is a prospective study which was conducted over a period of 1 year and included 100 patients.*
Results: *out of total 100 patients, majority (76%) had mild anaemia. Statistically significant correlation was found between serum ferritin and RDW ($P<0.05$) whereas no correlation was established between serum ferritin and PCV, MCV, MCH & MCHC.*
Conclusion: *RDW estimation is a preliminary diagnosis that can give an idea of iron deficiency anaemia but for final diagnosis serum ferritin should be done.*
Keywords: *Iron deficiency anaemia, Pregnant females, Red cell indices, Serum ferritin.*

Introduction

Anaemia is defined pathophysiologically as a decrease in oxygen carrying capacity of the blood. Anaemia in pregnancy is a major health problem especially in developing countries like India.[1] World health organization (WHO) has estimated that prevalence of anaemia in pregnant women was found 14% in developed, 51% in developing countries and 65-75% in India.[2] WHO defines anaemia in pregnancy when haemoglobin concentration in peripheral blood is 11g/dl or less. Deficiency of iron results when iron losses and requirements exceed absorption and is often multifactorial. The iron demands are markedly

increased during pregnancy because of expansion of red cell mass and transfer of increasing amount of iron to both developing foetus and placental structures Diminished intake of iron because of socio-economic factors, faulty dietary habits, loss of appetite and vomiting in pregnancy are the various other factors that contribute to iron deficient state during pregnancy. The most vulnerable groups to iron deficiency anaemia are pregnant females and infants as the iron demands and requirements are increased in them.

Maternal iron deficiency during pregnancy is associated with inadequate weight gain, anaemia, retarded foetal growth, low birth weights, still births, preterm delivery, intra uterine growth retardation, morbidity and mortality rates. Iron studies should be performed in all the pregnant females to assess the iron status and also to avoid the ill effects of iron deficiency to developing foetus and mother. Evaluation of iron deficiency anaemia involves peripheral smear examination, red blood cell indices, serum iron indices and is characterised by microcytic hypochromic blood picture and low iron stores. The red cell indices form the part of routine complete blood count and include total RBC count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), red cell distribution width (RDW). MCV is the measure of average size of red cell and ranges from 80-100 fl. MCH is the measure of concentration of haemoglobin in a given volume of packed red blood cells and ranges from 26-33pg. When these values are less than their normal reference range, the cells are said to be microcytic hypochromic.

There are many causes of microcytic hypochromic blood picture and among them the important ones are iron deficiency anaemia and thalassemia minor. As in both cases, MCV is low and picture is microcytic hypochromic, so it is difficult to differentiate between them on gross blood picture only.

RDW can detect even the small changes in red cell size and also gives an idea of early iron deficiency. However, serum ferritin is a gold standard for diagnosing iron deficiency anaemia but red cell indices can be used in collaboration with each other to get an idea of iron deficiency anaemia. Ferritin levels < 12ng/dl is considered as the gold standard for the diagnosis of iron deficiency anaemia in pregnancy.[3] Thelow sensitivity of transferrin saturation and day to day and even hour to hour fluctuation of serum iron levels made them less efficient than ferritin for diagnosing iron deficiency which is the only condition associated with low serum ferritin concentration, seems most appropriate.[4] Serum iron levels show fluctuations and can be high or normal if pregnant female is on iron tablets and hence less efficient than serum ferritin for diagnosing iron deficiency. Serum ferritin being an expensive and time consuming investigation cannot be routinely done in every patient, thus the need arises for alternative markers like red cell indices to determine their usefulness in diagnosing iron deficiency anaemia during the course of pregnancy. The present study was conducted to reflect the correlation between red cell indices and serum ferritin.

Material and Methods

This is an observational study conducted in the Postgraduate Department of Pathology in collaboration with Department of Obstetrics & Gynaecology, Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu (J&K) after obtaining due clearance from the Institutional Ethics committee. The primary aim of the study was to correlate red cell indices with serum ferritin in pregnant females with iron deficiency anaemia. The study was conducted over a period of 1 year from 1st November 2016 to 31st October 2017. 100 patients were evaluated for this observational study. Pregnant females presented with anaemia (Hb 11g/dl or less) formed the study group. Under all aseptic conditions, venous blood was collected with EDTA used as an anticoagulant for haemoglobin (Hb) estimation, hematocrit (PCV), mean

corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) estimation were done using Sysmex five part differential automated cell counter. Iron studies including serum ferritin, serum iron, total iron binding capacity (TIBC) and transferrin saturation (TSAT) were done. Serum ferritin estimation was done by enzyme linked immunosorbant assay method.

Results

The present study was prospective in nature. Among 100 patients in our study, 34 females (34%) were in the age group of 21-25 years followed by 31-35 and 36-40 years (20% each). 18% were in the age group of 26-30 years. Only 4 females were in the age group of 41-45 years and 15-20 years and none of them were more than 45 years in age. Majority of the pregnant females (76%) had mild anaemia i.e. Hb 8-10g/dl, while 18% of patients had moderate anaemia (Hb 7-7.9g/dl) and remaining 6% had severe anaemia (Hb ≤6.9g/dl). PCV was reduced and normal in equal number of patients i.e. 50% each. MCV was reduced in 48%, normal in 50% and increased in 2%. Whereas MCH was reduced in 62%, normal in 36% and increased in 2%.

Majority of the females (58%) had normal range of MCHC values i.e. 30-35 whereas 40% females had decreased MCHC values and only 2% had increased values. Majority of the pregnant females (78%) with iron deficiency anaemia had increased RDW values i.e. > 14.6. The value within normal range was found in only 22% females.

A total of 82(82%) patient had serum ferritin values less than 15ng/ml in the microcytic group and none of them had any evidence of iron deficiency having ferritin values more than 100ng/ml. 18 (18%) patients had ferritin in the range of 15-100ng/ml

Majority of the females with reduced serum ferritin had reduced MCH as depicted in fig 1. Whereas almost equal number of females had decreased as well as normal MCV (48% & 50%) respectively as shown in fig 2. PCV was reduced and normal in equal number of females i.e. 50% each (fig 3). Majority of the females with reduced serum ferritin also had increased RDW as depicted by fig 4.

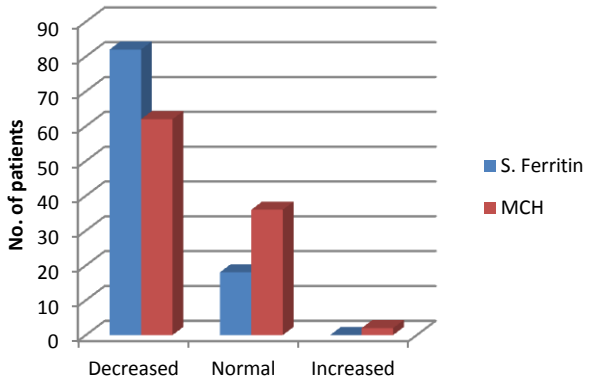

Fig 1: Showing S. Ferritin and MCH

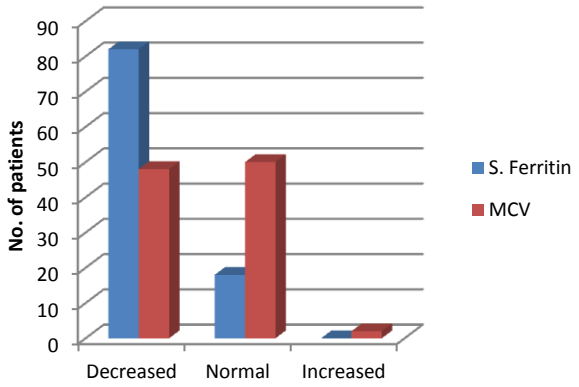

Fig 2: Depicting Serum Ferritin and MCV

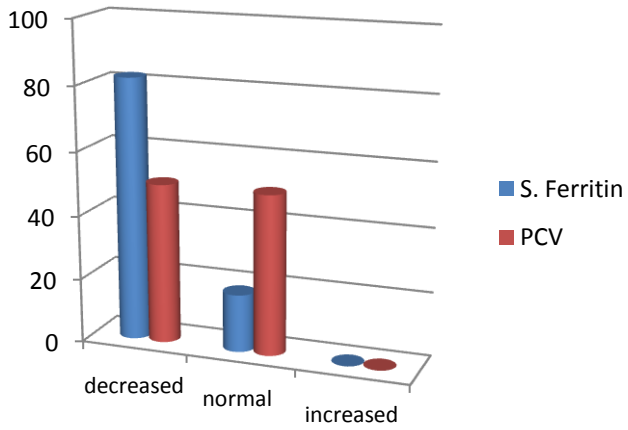

Fig 3: Showing PCV and S. Ferritin

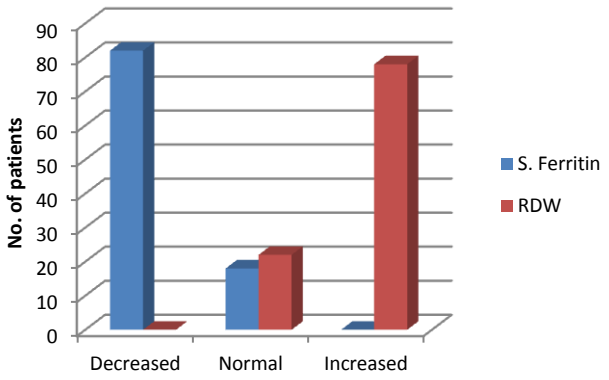

Fig 4: Showing S. Ferritin and RDW

Discussion

In our study, majority of the females (34%) were in the age group of 21-25 years, with the mean age of 23 years. And 20% each were in the age group of 31-35 years and 36-40 years. Our results were in agreement with the Indian study by Sharma and Nagar and Das et al.[2,5]

In the present study, majority of the pregnant females (76%) had mild anaemia i.e. haemoglobin 8-10g/dl with the mean of 9g/dl followed by moderate anaemia in 18% pregnant females. This was in accordance with the study by Kazmi et al where the majority of females had mild anaemia i.e. 10.1±2.0.[6] However our results were not consistent with the study by Sharma and Nagar.[2]

In the present study, 50% pregnant females (n=50) had low PCV i.e.<35.9% and another 50% had normal range of PCV i.e. 36-42%. This was comparable with the Indian study by Purohitet al.[7] Similar results were established by Sharma and Nagar in their study.[2]

In our study, MCV was normal in majority of the females. Abdelgader et al and Kazmi et al showed the similar findings in their study.[8,6]

In the present study, most of the females had low MCH values i.e. 62% females had MCH value ≤26.9pg while 36% had normal MCH values i.e. between 27-32pg and only 2% had increased values. These results were comparable with the Indian study by Sharma and Nagar who showed that majority of the females had low MCH values.[2] Also, similar results were observed by another study conducted by Kazmi et al.[6]

In the present study, MCHC values were normal i.e. 30-35g/dl in 58% of the females (n=58) and 40% (n=40) had low MCHC values whereas only 2% had increased values. This was comparable with the study by Abdelgader et al who concluded that 78 (97.5%) had normal MCHC values followed by low MCHC in 2.5% (n=2).[8]The results were also comparable with the study by Purohit et al.[7] Whereas the results were not in accordance with the study by Sharma and Nagar.[2]

In our study, majority of the females had increased RDW**.** Our results concorded well with the studies done by Kazmi et al, Sultana et al and Bessman et al.[6,9,10] Also similar results were found by Adil et al and Viswanath et al who in their studies concluded that 100% of the patients with iron deficiency anaemia had increased RDW.[11,12]

In present study, S. Ferritin levels were decreased in majority of the pregnant females (n=82) and the normal levels were found in only 18% of the females (n=18) whereas none of the pregnant female studied had increased levels. This finding of ours was in agreement with the findings reported by Abdelgader et al.[8] Similar results were also established by Dale et al and Hallberg and Hulten.[13,14]

In the present study, it was found that majority of the females with low levels of S. Ferritin during pregnancy had increased RDW. Thus, the inverse relationship was found between S. Ferritin and RDW. Correlation of RDW with serum ferritin was assessed for iron deficient cases to see if it could pick up iron deficiency anaemia and statistically significant correlation was found between them (P<0.05) . Thus RDW is one of the important indicators of early iron deficiency in an individual. Our results were in concordance with the Indian study by Tiwari et al they carried out the study in 100 pregnant females and established the correlation between S. Ferritin and RDW.[3] Similar results were also established by other studies.[9,15]

In the present study, low S. Ferritin levels were found in majority of the females whereas normal

and reduced MCV values were present in almost equal number of pregnant females i.e. 50% &48% respectively. Also, MCH was normal and reduced in 36% and 62% pregnant females respectively. MCHC was also comparable in majority of the patients. And equal number of pregnant females had low as well as normal PCV i.e. 50% each. Pearson correlation coefficient was used for analysis of various indices and P value was found to be >0.05. Thus no correlation was found between S. Ferritin and PCV, MCV, MCH & MCHC. These results were in agreement with the study by Kazmi et al.[6] Other studies also found low sensitivity and high specificity of MCV. [16,17]

Conclusion

From the present study it is concluded that RDW is a routinely used parameter that can give an idea of early iron deficiency before other test. Though serum ferritin estimation is a gold standard but it is costly method for diagnosis of IDA. Also in view of increased prevalence of anaemia in our country, there is a need to find an alternative cost effective method/parameter for early diagnosis of IDA. RDW is a more reliable indicator than any other red cell indices for iron deficiency especially in pregnancy. RDW can best predict the iron deficiency as it can detect a small variation in red cell size which is an earliest morphological change in IDA. RDW estimation is a preliminary diagnosis that can give an idea of IDA but for final diagnosis serum ferritin should be done.

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