Original Article

A study of significance of plasma and red cell volumes during pregnancy

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Abstract

Background: Anemia is a major public health problem. It is now one of the most frequently observed nutritional diseases in the world. **Aims and Objectives:** To Study Significance of Plasma and Red Cell Volumes during Pregnancy. **Material and Methods:** This study anemia in pregnancy was conducted in department of pathology in collaboration with department. Was carried out in 11 months-from January 2014 to November 2014 in Total 400 cases of pregnant females attending antenatal OPD. Statistical analysis by chi-square test calculated by SPSS 19 version of software, P value <0.05 was taken as significant. In the study of 400 patients. 359 cases (89.5%) were of microcytic hypochromic anemia, 34 cases (8.75%) were of macrocytic hypochromic anemia and 7 cases (1.75%) of dimorphic anemia. **Results:** Highest percentage of all grades of anemia was found in age range of 21-30yrs.Microcytic hypochromic anemia was predominant type of anemia in 21-30 age groups (P<0.001). Microcytic hypochromic anemia was predominant in all gravida (P>0.14). In all trimesters, microcytic hypochromic anemia was predominant type of anemia. (P>0.05) In all grades of anemia Dimorphic anemia was most common 71.42% followed by Microcytic hypochromic anemia 68.80% and Macrocytic hypochromic anemia was 55.88% (P>0.05). **Conclusions:** Prevalence of anemia was high in pregnancy i.e. 39.4%, Highest percentage of anemia was seen in third trimester Anemia was predominantly seen in primigravidae, 21-30 years was the most commonly affected age group Moderate anemia was the predominant grade of anemia in all age group all gravidae and all trimesters, Microcytic hypochromic anemia was the predominant morphological type of anemia in all age ranges, all gravidae and all trimester. There was statistically significant association between age and morphological type of anemia.

Key Words: Red Cell Volumes, MCV, MCHC, PCV, Anemia in Pregnancy.

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INTRODUCTION

Anemia is a major public health problem. It is now one of the most frequently observed nutritional diseases in the world. It is especially prevalent in women of reproductive age, particularly during pregnancy. Pregnancy is one of the unique periods of women's life cycle. It is a condition of great stress because many anabolic activities take place and fetal growth is accomplished by extensive changes in maternal body composition and metabolism. Maternal nutrition is the most important determinant that influences the development of fetus. Poor nutritional status during pregnancy is associated with inadequate weight gain, retarded fetal growth low birth weight, still births, preterm delivery, intrauterine growth retardation, morbidity and mortality rates.[1] The importance and significance of the knowledge of haematological parameters in advanced pregnancy stems from the fact that anemia especially iron deficiency anemia is the most common ailment affecting pregnant women of India. Most of the data available about the heamatological parameters of pregnant women are the results of studies carried out in western countries which does not apply for India women. The cultural and socio-economic difference between the western countries and India have contributed to the difference in basic physiological values there and here. For instance Hb level of 11 gm/dl in an adult Indian women is considered as average whereas a similar values in the west may be a cause for concern. Because of these

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difference it becomes essential to carry out a study on the haematological parameters in pregnancy in India. Aneamia is the most common heamatological disorder during pregnancy. The main cause of anemia in developed countries include; inadequate intake and poor absorption of iron, malaria, hookworm infestation. Diarrhea. HIV/AIDS and other infections, genetic disorders(e.g. sickle cell and thalassemia), blood loss during labour and delivery, heavy menstrual blood flow and closely spaced pregnancies.[2] iron deficiency and anemia perinatal and neonatal mortality, inadequate iron stores for the newborn, increased risk of maternal morbidity and mortality, and lowered physical activity, mental concentration, and productivity.[3] Several studies on intra-household food allocation show that women get less foot than man relative to their nutritional needs[4]. Unequal access to food, heavy work demands, nutritional deficiencies including iron, makes Indian women susceptible to illness, and anemia.[5] low intake of ascorbic acid and meat, due to low income reduces the absorption of iron[6]. While malnutrition is prevailing among all segments of the population, poor nutrition among women begins in early years and continues during their lifetime. Usually, female members in a family are the last to eat. Consequently, it there is not enough food they are the ones to suffer mainly.[7]in 1993, the world health organization instituted its safe motherhood initiative with a goal of reducing the number of maternal death by half before the year 2000. A key component was to eradicate anemia in pregnancy. Focusing on the greater risk in younger women. Little progress has been made in reducing iron-deficiency anemia among women in developing countries, in spite of the introduction of iron supplementation programs in many of them.[8] WHO has estimated that prevalence of anemia in pregnant women was found 4% in developed, 51% in developing countries and 65-75% in India. Prevalence of anemia in all the groups is higher in India as compared to other countries.[9,10] WHO recommends that hemoglobin ideally should be maintained at or above 11.0gm/dl, and should not be allowed to fall below 10.5gm/dl in the second trimester. Anemia contributes to low birth weight and miscarriage and is also a primary cause of low immunity of both mother and child, that makes them vulnerable to several infestations.[20]

MATERIAL AND METHODS

This study anemia in pregnancy was conducted in department of pathology in collaboration with department Was carried out in 11 months-from January 2014 to November 2014 in Total 400 cases of pregnant females attending antenatal OPD having Hb<11gm/dl in first and third trimester of pregnancy. Hb<10.5gm/dl in second trimester of pregnancy.[10] All pregnant females of age>18 years attending ANC clinic with- Hb<11gm/ld in first third trimester of pregnancy, Hb<10.5gm/dl in second trimester of pregnancy were included into study while all pregnant females of age <18 years, pregnant females with Hb>11gm/ld in first and third trimester of pregnancy and Hb/10.5gm/ld in second trimester of pregnancy, pregnant females with other comorbid condition which can contribute to anemia were excluded from the study. Comprised of pregnant females with, first trimester of pregnancy with Hb<11gm/dl, second trimester of pregnancy with Hb<10.5gm/dl, third trimester of pregnancy with Hb<11gm/dl. Morphological typing of anemia was done using following criteria[11] Microcytic hypochromic anemia, RBCs with a diameter <7.0um and MCV<80 fl and central pallor more than 1/3rd of the RBC. Macrocytic hypochromic anemia-RBCs larger than normal RBCs having a diameter> 8.0 um and MCV>100 fl and central pallor more than 1/3 of the RBC. Dimorphic Anemia-Smear showing both microcytic and macrocytic forms of RBCs. Grading of anemia was done using following cut off values of hemoglobinMild-10 to 11gm/dlModerate-7 to 9.9 gm/dl, Severe-<7 gm/dl. Statistical analysis by chi-square test calculated by SPSS 19 version of software, P value <0.05 was taken as significant.

RESULT

Table 1: Peripheral smear examination (n=400)

Peripheral smear	Number of cases	Percentage
Microcytic hypochromic anemia	359	89. 5
Macrocytic hypochromic anemia	34	8.75
Dimorphic anemia	7	1.75
Total	**400**	**100**

In the study of 400 patients. 359 cases (89.5%) were of microcytic hypochromic anemia, 34 cases (8.75%) were of macrocytic hypochromic anemia and 7 cases (1.75%) of dimorphic anemia.

Table 2: Grade of anemia (n=400)

Grade of anemia	Number of cases	Percentage
Severe	63	15.75
Moderate	271	67.75
Mild	66	16.5
Total	**400**	**100**

Among 400 cases of anemia, only 66 cases (16.5%) were mildly anemic. Whereas 83.5% of women were either moderately or severely anemic (67.75%) moderate anemia and 15.75% cases of severe anemia).

Table 3: Correlation of age with grade of anemia (n=400)

Age in years	Severe anemia	Moderate anemia	Mild anemia	P value
18-20	9(14.18%)	41(15.12%)	8(12.12%)	
21-25	29(46.9%)	119(43.9%)	32(48.48%)	
26-30	22(34.92%)	97(35.7%)	18(27.27%)	0.4
31-35	3(4.7%)	14(5.1%)	8(12.12%)	
Total	**36(100%)**	**271(100%)**	**66(100%)**	

In all age groups, moderate anemia was predominant. Highest percentage of all grades of anemia was found in age range of 21-30yrs.

Table 4: Correlation of age with morphological type of anemia (n=400)

Age	Microcytic hypochromic anemia	Macrocytic hypochromic anemia	Dimorphic anemia	P value
18-20	52(14.48%)	5(14.7%)	1(14.28%)	
21-25	173(48.18%)	6(17.64%)	1(14.28%)	
26-30	114(31.75%)	17(50%)	5(71.42%)	0.001
31-35	20(5.57%)	6(17.64%)	Nil	
Total	**359**	**34**	**7**	

After correlating age with type of anemia we found that 52 cases in the age group of 18-20 years, 173 cases in 21-25 years,114 cases in 26-30 years and 20 cases in the age group of 31-35 years were showing microcytic hypochromic anemia.5 cases in the age group of 18-20 years,6 cases in 21-25 years, 17 cases in 26-30 years,6 cases in31-35 years showed macrocytic hypochromic anemia. 1 case in age group of18-20 years 1case in 21-25 years, 5 cases in 26-30 years showed Dimorphic anemia. Microcytic hypochromic anemia was predominant type of anemia in all age groups. (P<0.001)

Table 5: Correlation of gravida with type of anemia (n=400)

Gravida	Microcytic hypochromic anemia	Macrocytic hypochromic anemia	Dimorphic anemia	P value
1	158(44%)	9(26.47%)	2(28.57%)	
2	137(38.16%)	17(50%)	2(28.57%)	
3	57(15.87%)	7(20.58%)	2(28.57%)	
4	7(1.94%)	1(2.94%)	1(14.28%)	0.14
Total	**359(100%)**	**34(100%)**	**7(100%)**	

Microcytic hypochromic anemia was predominant in all gravida (P>0.14)

Table 6: Correlation of trimester with type of anemia (n=400)

Trimester	Microcytic hypochromic	Macrocytic hypochromic anemia	Dimorphic anemia	P value
I	33(9.1%)	3(8.8%)	1(14.28%)	
II	138(38.44%)	11(32.35%)	4(57.14%)	
III	188(52.36%)	20(58.82%)	2(28.57%)	0.69
Total	**359(100%)**	**34(100%)**	**7(100%)**	

In all trimesters, microcytic hypochromic anemia was predominant type of anemia.(P>0.05)

Table 7: Correlation of grade of anemia with type of anemia (n=400)

Grade	Microcytic hypochromic anemia	Macrocytic hypochromic anemia	Dimorphic anemia	P values
Mild	54(15.04%)	11(32.35%)	1(14.28%)	
Moderate	247(68.80%)	19(55.88%)	5(71.42%)	0.14
Severe	58(16.15%)	4(11.76%)	1(14.28%)	
Total	**359(100%)**	**34(100%)**	**7(100%)**	

In all grades of anemia Dimorphic anemia was most common 71.42% followed by Microcytic hypochromic anemia 68.80% and Macrocytic hypochromic anemia was 55.88% (P>0.05).

Table 8: Mean values of all parameters in all three trimesters

Trimester	HB(gm/dl)	RBC	MCV(fl)	MCH(p9)	MCHC (%)	PCV
I	8.6	4.04	78	23.37	29.17	31.2
II	8.5	3.9	76.87	24.22	29.58	31.06
III	8.2	3.8	75	23.27	29.01	30.9

From above table it is clear that with each Trimester there is decrease in mean, HB(gm/dl), RBC, MCV(fl), MCH(p9), MCHC (%),PCV.

DISCUSSION

Anemia is the most frequently observed nutritional disease in the world; also most commonly encountered medical disorders during pregnancy. In developing countries it is a major public health problem and a cause of serious concern as besides many other adverse effects on mother and fetus it contributes significantly to maternal mortality. Brabin *et al* found a strong association of severe anemia with maternal mortality.[13] It is disturbing to find that the prevalence of anemia in developing countries is still high, nearly half of the pregnant women in the world are estimated to be anemiac, i.e. 52% in non-industrialized compared to 23%in industrialized countries. 38 also recent WHO data shows that approximately 17.2 million in African countries, 7.6 million in western pacific and 18 million pregnant women in south east Asia are anemia. The highest number being in south east asia.[14] In India anemia is the second most common cause of maternal death, accounting for 20% of fotal maternal death[15] Prevalence of anemia in different regions of India ranges from 33% to 100%.[42] pregnant women from rural Maharashtra registered a prevalence of 56.4%. nadeem *et al* in a study conducted in Loni, in district Ahmednagar found 74.84% prevalence of anemia.[17] Age is known risk factor for anemia. As we age, a greater proportion of our bone narrow is replaced with fat, leaving fewer hematopoietic elements. Our study closely resembles with study by Rasheed P *et al* ad Amar Shah *et al*. Our study found 52.5% cases in 3rd trimester 38.5% in 2nd trimester, and

9% in 3rd trimester. Our study correlates with report of WHO in which anemia is said to be significantly higher in third trimester. Also Few of studies show predominance of anemia in 2nd trimester. This predominance of anemia in third trimester can be explained by the fact that there occurs hemodilution in second and third trimester of pregnancy, which leads to physiological anemia of pregnancy. Actually RBC mass is increased towards second and third trimester but plasma volume is also increased and this increase is disproportionate to the increase in RBC mass. This produces a state of hemodilution.[18] On peripheral smear examination out of 400 we found 359 cases (89.5%) of Microcytic hypochromic anemia, 34 cases (8.75%) of Macrocytic hypochromic anemia (fig2) and cases (1.75%) of Dimorphic aemia (fig 3) So microcytic hypochromic anemia (fig1) was the predominat type of morphological type of anemia no similar studies were found in literature search. However studies by JB Sharma *et al*[35], Nadeem Ahmad *et al*[17], also found that iron deficiency anemia (microcytic hypochromic) was predominant anemia in pregnancy in all age groups. On correlating gravida with type of anemia maximum cases of microcylic hypochromic anemia were in primigrvidae and that of macrocytic hypochromic anemia were in gravid II. On correlating trimester with type of anemiamaximum cases of microcytic hypochromic anemia were in primigrvidae and that of macrocytic hypochromic anemia were in gravid II. On correlating trimester with type of anemia all morphological types were predominant in third trimester. P value for this correlation was 0.69 i.e. not significant. So this correlation was also not statically significant.

Table 9: Mean values of all parameters in all three trimesters

Trimester	HB(gm/dl)	RBC	MCV(fl)	MCH(p9)	MCHC (%)	PCV
I	8.6	4.04	78	23.37	29.17	31.2
II	8.5	3.9	76.87	24.22	29.58	31.06
III	8.2	3.8	75	23.27	29.01	30.9

As mentioned in above table HB level has dropped marginally from 1st trimester to 3rd trimester. So also the RBC, MCV, MCH, MCHC and PCV. Hematological changes in pregnancy are in response to the rapidly growing fetus placenta and their increasing demands with increase in maternal oxygen consumption, cardiac output (peak at 25.285 weeks) and blood volume (peak at 12 weeks) Alternation in cardiac output bear no relation to changes in blood volume. The major role in raising cardiac output is played by increases strokes volume, with small elevation of cardiac rate. The Hb level, RBC count and the heamatocrit fall progressively form the end of the first trimester until a few weeks, before term, returning to normal 1.2 months postpartum. Bone marrow hyperplasia with neutrophilic leukocytosis seen during last trimester. The plasma volume reaches its peak by the 7th month and varies only slightly during the 8th or 9 month. Though there is increase in RBC production, and so also an increase in concentration. Expansion of plasma volume occurs by 310-ml between 6 and 12 weeks and by 14% at 12 weeks 58 Red cell mass also increases by 10%-20% but the net result is that hemoglobin (Hb) concentration falls typically by 1-2 g/dl by the late second trimester and stabilizes thereafter women who take iron supplements have less pronounced Hb changes, as they increase their red call mass proportionately more than those without dietary supplements (the increase is approximately 30% over pre-pregnancy)[19]

CONCLUSIONS

Prevalence of anemia was high in pregnancy i.e. 39.4%, Highest percentage of anemia was seen in third trimester Anemia was predominantly seen in primigravidae, 21-30 years was the most commonly affected age group Moderate anemia was the predominant grade of anemia in all age group all gravidae and all trimesters, Microcytic hypochromic anemia was the predominant morphological type of anemia in all age ranges, all gravidae and all trimester. There was statistically significant association between age and morphological type of anemia.

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