Study of hematological parameters in anemia in pregnancy in a tertiary care hospital

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Abstract
Background: Anemia is the most common hematological disorder during pregnancy. The knowledge of hematological parameters in pregnancy can help in preventing the complications due to anemia. There is a need to monitor these parameters during pregnancy. The aim of this study was to determine the hematological profile of anemic pregnant women who were attending antenatal hospital. **Material and Methods:** This cross sectional study was carried out in 400 pregnant females with Hb<11gm/dl in first and third trimester of pregnancy and Hb<10.5gm/dl in second trimester of pregnancy. Blood samples were collected by qualified technician for hematological estimation. **Results:** The prevalence of anemia in our institute was 39.4%.Mean hemoglobin for all anemic pregnant women was 8.4 gm/dl. Out of 400 cases, 180 (45%) were in age group of 21-25 years. In all age groups moderate, microcytic hypochromic anemiaduring third trimester was predominant. Other hematological parameters like RBC, MCV, HCT, MCHC, MCH were also below the normal range. **Discussion:** Although the individual hematological parameters have their limitations but a combination of different parameters improves their clinical utility. The hematological parameters help in early diagnosis of anemia which warrants adequate clinical attention, to find out the cause, type, severity and treatment of anemia.
Key Words: Anemia, Pregnancy, Hematological parameters, gravidae.

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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 and especially prevalent in women of reproductive age, particularly during pregnancy. Pregnancy, one of the unique periods of women's life cycle, is a condition of great stress due to many anabolic activities. Maternal nutrition is the most important determinant that influences the development of fetus. Poor nutritional status during pregnancy is associated with inadequate weight gain, retards fetal growth low birth weight, still births, preterm delivery, intrauterine growth retardation, morbidity and mortality rates[1]. World Health Organization (WHO) recommends that hemoglobin ideally should be maintained at or above 11 gm/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[2]. Anemia is the most common hematological disorder during pregnancy. Inadequate intake and poor absorption of iron, malaria, hookworm infestation, diarrhea, HIV/AIDS and other infections, blood loss during delivery, heavy menstrual blood flow and closely spaced pregnancies are the main causes of anemia in developing countries[3]. WHO has estimated that prevalence of anemia in pregnant women to be 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[4]. The importance and significance of the knowledge of hematological 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 hematological parameters of pregnant women are the results of studies

carried out in western countries which does not apply for Indian women. Therefore, it becomes essential to carry out a study on the hematological parameters in pregnancy in India.

MATERIAL AND METHODS

This cross sectional study was carried out in 400 pregnant females attending antenatal clinic in a tertiary care hospital with Hb<11gm/dl in first and third trimester of pregnancy and Hb<10.5gm/dl in second trimester of pregnancy[5]. All pregnant females of age <18 years, pregnant females with Hb>11gm/dl in first and third trimester of pregnancy and Hb>10.5gm/dl in second trimester of pregnancy and pregnant females with other co-morbid condition which can contribute to anemia were excluded from the study. History and other clinical details of each patientwere recorded and informed written consent was taken from each patients. Hematological investigations were performed immediately on PCE 210 ERMA automated hematology analyzer with standard calibration used. Hematological parameters were obtained by automated hematology analyzer. A good peripheral blood smear was made and stained with Leishman's stain. Morphological typing of anemia was done using following criteria[6]

1. Microcytic hypochromic anemia-RBCs with a diameter <7.0μm and MCV<80 fl and central pallor more than 1/3rd of the RBC.
2. Macrocytic hypochromic anemia-RBCs larger than normal RBCs having a diameter>8 μm and MCV>100 fl and central pallor more than 1/3[rd]of the RBC
3. Dimorphic Anemia- smear showing both microcytic and macrocytic forms of RBCs.

Grading of anemia was done using following cut off values of hemoglobin[7]

Mild anemia -10 to 11gm/dl
Moderate anemia -7 to 9.9 gm/dl
Severe anemia -<7 gm/dl

Statistical Analysis

After data collection data analysis was done by appropriate statistical software. Qualitative data was presented with the help of frequency and percentage table. Quantitative data was presented with the help of mean and standard deviation. Association among various parameters was assessed by Chi-square test. P value <0.05 was taken as significant.

RESULTS

In this prospective clinical non controlled study a total of 400 pregnant females attending antenatal clinic in a tertiary care hospital, over a period of 11 months from January 2014 to November 2014 were included.

Considering the total number of pregnant females attending antenatal OPD over the study period, prevalence of anemia in our institute was 39.4%. Among all 400 cases youngest age was 17 years and oldest was 35 years. Mean age was 24 years with a standard deviation of 3.75. In age wise distribution of anemia, 58 cases (14.5%) were in the age group of 18-20 years. 180 cases (45%) in age group of 21-25 years, 137 cases (34.28%) between 26-30 years and 25 cases (6.25%) in 31-35 years. Maximum number of cases were in age group of 21-30 years i.e., 79%. 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%) of moderate anemia and 15.75% cases of severe anemia.

Table 1: 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 2: Correlation of age with morphological type of anemia (n=400)

Age (yrs)	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	

Microcytic hypochromic anemia was predominant type of anemia in all age groups. Out 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 3: Correlations of trimester with grade of anemia(n=400)

Trimester	Severe anemia	Moderate anemia	Mild anemia	P values
I	4(6.3%)	27(9.9%)	5(7.57%)	
II	20(31.74%)	103(38%)	31(46.96%)	0.32
III	39(61.9%)	141(52%)	30(45.45%)	
Total	63(100%)	271(100%)	66(100%)	

All grades of anemia were predominantly seen in third trimester. In trimester wise distribution of anemia 36 cases (9%) were seen in 1st trimester, 154 cases (38.5%) were in 2nd trimester and 210 cases (52.5%) in 3rd trimester. So, anemia was predominantly found in 3rd trimester.

Table 4: Correlation of gravid with grade of anemic (n=400)

Gravida	Severe anemia	Moderate anemia	Mild anemia	P value
1	28(44.44%)	103(38%)	37(56.06%)	
2	25(39.68%)	116(42.8%)	15(22.72%)	
3	8(12.69%)	46(73.01%)	13(19.69%)	
4	2(3.17%)	6(2.21%)	1(1.51%)	0.08
Total	63(100%)	271(100%)	66(100%)	

Moderate anemia was predominant form of anemia in all gravidae. In gravida-wise distribution of anemia 42% i.e., 168 cases were primigravidas, 39% i.e. 156 cases were gravid II, 16.75% i.e., 67 cases were gravid III, 2.25% i.e., 9 cases were gravid IV. Thus, anemia was predominantly seen in primigravidas. However, the above observation was more so because of higher percentage of admission of primigravidae over multigravidae to the hospital in this period. Mean hemoglobin for all anemia pregnant women in our study was 8.4 gm/dl (SD=1.46). Mean age of anemic cases in our study was 24 years (SD=3.75). Mean MCV was 76 fl (SD=13.77), mean MCH was 23.65 pg (SD=6.12) and mean MCHC was 29.27% (SD=2.79) and mean RBC count was 3.88 million/cum. Mean Hbof 8.4 gm/dl again indicates predominance of moderate anemia. Mean Hb in mild anemia cases was 10.19 gm/dl, in moderate anemia it was 8.5gm/dl and in severe anemia it was 6.01gm/dl.

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 gravidae.

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

Trimester	Microcytic hypochromic anemia	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%)	
Total	359(100%)	34(100%)	7(100%)	0.69

In all trimesters microcytic hypochromic anemia was predominant type of anemia.

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

Grade of anemia	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%)	
Severe	58(16.15%)	4(11.76%)	1(14.28%)	0.14
Total	359(100%)	34(100%)	7(100%)	

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. Barbin *et al* found a strong association of severe anemia with maternal mortality[4]. 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 anemic, i.e., 52% in non-industrialized compared to 23%in industrialized countries[8]. In India anemia is the second most common cause of maternal death, accounting for 20% of fetal maternal death[9]. Prevalence of anemia in different regions of India ranges from 33% to 100%[10]. Pregnant women from rural Maharashtra registered a prevalence of 56.4%. Nadeem *et al* in a study conducted in Loni, found 74.84% prevalence of anemia[11]. Gautam VP *et al* in rural area of Delhi found a very high prevalence of anemia i.e., 96.5%, such a high prevalence was found in rural area of national capital[12]. Kapil *et al*[13] and Pathak *et al*[14] recorded prevalence of 78.8% and85.4% in slums of Delhi respectively. 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 results resemble closely with studies by Gautam VP *et al*[12] and Shah A *et al*[15]. In a study by Sharma P *et al*[16] 18% cases were in age group 18-20 years, 54% in age group of 21-25 years and 30% cases were in the age group of 26-35 years. Nadeem A *et al*[11] found 45.8% cases in 18-20 years age group, 30.9% cases in 21-25, 20.9% in 26-30 years and 2.36% cases in 31-35 years. Gautam VP *et al*[12] found 19.30% cases in 18-20 years, 56.14% in 21-25 years, 56.14% in 21-25 years in 18-20 years age group, 53.6% in 21-25 years. Shah A *et al*[15] recorded 3.9% cases in 18-20 years, 51% in 21-25 years, 33.4% in 26-30 years age group and 9.8% in 31-35 years age group. As started by National Family Health Survey-3, anemia in women is more or less same in all age groups. So age is not an important determinant of anemia for general population of women[4].

Our study closely resembles with study by Rasheed P et al[17] and Shah et al[15]. Our study found 52.5% cases in 3rd trimester 38.5% in 2nd trimester, and 9% in 3rd trimester. Study by Rasheed et al[17] shows 50.2% cases in 3rd trimester, 37.3% cases in 2nd trimester 27.7% cases in 1st trimester. In the study of Shah et al[15] 41% cases are in 3rd trimester, 39.2% in 2nd trimester, and 19.7% in 1st trimester. Many other studies also show predominance of anemia in third trimester. Our study correlates with report of WHO in which anemia is said to be significantly higher in third trimester. Also, few of the studies show predominance of anemia in 2nd trimester. A study by Abel et al[18] stated that mean hemoglobin level was significantly higher in 3rd trimester than in 1st and 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[19]. In our study 56% cases were gravid II and gravid III, 42% were primigravidae and 2% were Gravida IV. Shah et al[15] also found 45.1% of primigravidae and 54.9% of multigravidae anemic. Our study resembles with study by Nadeem A et al[11] who found 30.17% mildly anemic, 50.86% moderately anemic and 18.96% severely anemic pregnant women. Study by Sharma et al[16] showed 40.29% mildly anemic, 54.54% moderately anemic and 4.54% severely anemic pregnant females. Study by Gautam VP et al[12] showed 22.8% mildly anemic. 50.9% moderately anemic and 22.8% severely anemic pregnant females. Shah et al[15] found 59% cases of moderate anemia, 17% of mild anemia and 24% of severe anemia. On peripheral smear examination, we found 359 cases (89.5%) of microcytic hypochromic anemia as the predominant type of morphological type of anemia no similar studies were found in literature search. However, studies by Sharma et al[5], Nadeem A et al[11] and Belgnoul et al[20] also found that iron deficiency anemia (microcytic hypochromic) was predominant anemia in pregnancy in all age groups. On correlating age with type of anemia, microcytic hypochromic anemia was found to be the predominant form of anemia in all age groups and maximum cases of all three types of anemia were seen in the age range of 21-30 years (P value=0.001; significant). So, there was statistically significant association between age group and type of anemia. On correlation of trimester with grade of anemia, moderate and severe anemia were predominant in third trimester and mild anemia was almost equally prevalent in third and second trimester (p value=0.32; not significant).Maximum cases of microcytic hypochromic anemia were in primigravidae and that of macrocytic hypochromic anemia were in gravid II. On correlating trimester with type of anemia, maximum cases of microcytic hypochromic anemia were in primigravidae 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=0.69; not significant). All grades of anemia were predominantly microcytic hypochromic morphologically. 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 25.2 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 hematocrit 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 9th months, though there is an 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. Red cell mass also increases by 10%-20% but the net result is that hemoglobin 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)[21]. The individual hematological parameters have their limitations but a combination of different parameters improves their clinical utility. The hematological parameters are easy to perform and when properly interpreted it can help in early diagnosis of anemia which warrants adequate clinical attention, to find out the cause, type, severity and treatment of anemia.

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