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Study of Proportion of Anemia and Variation of Hematological Parameters in Pregnancy

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Abstract

Introduction: *Anemia in pregnancy is very common in India and one of the major cause of maternal mortality. Pregnancy leads to physiological anemia but may turn in to Pathological anemia in advanced pregnancy.*

It was WHO has estimated that prevalence of anemia in developed and developing countries in pregnant women are 14% and 51% respectively and in India, it is observed that mean Hemoglobin (Hb) level was inversely related parity.

About one third of the global population are anemic and anemia during pregnancy is considered significant as it leads to fetal and maternal disorders. Anemia during pregnancy is considered severe when Hb% is less than 7.0 gm/dl, moderate when Hb% falls between 7.0-9.9 gm/dl and mild form 10 to 10.9 gm/dl. Pregnant women are prone to develop anemia because they tend to have an increased demand of iron to increase their erythrocyte mass and to supply iron to the developing fetus.

Methodology: *The present study comprised of 205 Antenatal patients. Blood sample of all Pregnant women who came for antenatal check up to the department of Obstetrics & Gynecology, Sri Manakula Vinayagar Medical College & Hospital [SMVMCH] puducherry in the reproductive age group (19-45years) was taken during the study period of 18 months. Out of 205 pregnant women, 45 of them were registered in the 1st trimester. The remaining 80 were registered in the 2nd & 80 in 3rd trimester respectively. Detailed history including literacy and socioeconomic status was noted.*

Results: *Out of 205 patients, 80(39.1%) were diagnosed as iron deficiency anemia followed by 43(20.9%) as dimorphic anemia, 37(18.1%) Normocytic Normochromic anemia, 45(21.9%) as normal blood picture from the peripheral smear and from the results of complete blood counts.*

Iron deficiency anemia was the most common disease group in the present study followed by dimorphic anemia and lastly Normocytic Normochromic anemia. Iron deficiency anemia was more prevalent among patients of third trimester.

Conclusion: *Anemia is a wide spread global public health problem. Women are particularly vulnerable, and more than half of all pregnant women in developing countries suffer from anemia. Iron deficiency is the primary cause, but a variety of other nutritional deficiencies and infectious diseases contribute*

significantly to the global burden of anemia. The consequences of anemia are serious and include economic losses, maternal mortality and adverse birth outcomes. It can be concluded that altered hematological indices such as hemoglobin, red blood cell (RBC) count, white blood cell (WBC) count,)packed cell volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) are seen during normal pregnancy. Educating women on early ANC booking and compliance with the use of balance diet, adequate nutritional supplements prescribed medications should also be emphasised.

Keywords: *anemia, pregnancy, proportion, packed red cell, hematological variations.*

Introduction

Anemia is defined as a condition in which there is less than the normal hemoglobin (Hgb) level in the body, which decreases oxygen-carrying capacity of red blood cells to tissues. World Health Organization (WHO) definitions for anemia differ by age, sex and pregnancy status as follows: children 6 months to 5 years anemia is defined as a Hgb level <11g/dl, children 5–11 years Hgb < 11.5 g/dl, adult males Hgb < 13 g/dl; non pregnant women Hgb <12g/dl and pregnant women Hgb < 11g/dl.[1] Anemia could be classified as mild, moderate and severe. The Hgb level for each class of anemia in pregnancy are 10.0–10.9g/d1 (mild), 7–9.9g/dl (moderate) and <7g/ dl (severe)[2].

Anemia in pregnant women is often caused by iron deficiency, which is the most common nutrient deficiency in the world. It has been estimated that, in developing countries, half of the population (mainly children and women of reproductive age) is affected by anemia[3]. Anemia also could be caused due to increased hemolysis, diminished erythropoesis and blood loss[4].. Anemia is also considered as an indicator of both poor nutrition and health status. The most dramatic health effects of anemia, increased risk of maternal and child mortality due to severe anemia, have been well documented.[1,5,6]

Examination of a stained blood smear using a microscope for morphology of red blood cell is helpful in diagnosing anemia in areas where automated analysis is less accessible[7].

Hemoglobin concentration is the most reliable indicator of anemia at the population level. Measuring Hgb concentration is relatively easy and in expensive, and this measurement is frequently used as a proxy indicator of iron deficiency[7]. It is estimated that approximately 1.3 billion individuals in the world suffer from anemia, making it one of the most important public health issues on the international agenda.[8,9] The knowledge of the prevalence of anemia in pregnant women is fundamental for the planning and execution of effective interventions by health authorities[10]. It is more common in developing countries because of poor nutritional status and high prevalence parasitic infestation[11]. Several studies indicated the association of anemia with maternal morbidity and mortality.[1,12] It has been reported that close to 500,000 maternal deaths occur every year, vast majority of them taking place in developing world.[1,13]

Aims and Objectives

- To study the proportion of anemia in pregnant women.
- To grade the severity of anemia in pregnant women.
- To know the morphology of different types of anemia

Materials and Methods

The present study comprised of 205 Antenatal patients. Blood sample of all pregnant women who came for antenatal check up to the department of Obstetrics & Gynecology, Sri Manakula Vinayagar Medical College & Hospital [SMVMCH] puducherry in the reproductive age group (19-45years) was taken during the study period of 18 months. Out of 205 pregnant women, 45 of them were registered in the 1st trimester. The remaining 80 were registered in the 2nd & 80 in 3rd trimester respectively. Detailed history

including literacy and socioeconomic status was noted.

Inclusion criteria: total of 205 antenatal patients

Exclusion criteria: No exclusion criterion in this study

Data collection tools

- Complete blood count
- Haemoglobin percent,
- PCV, MCV, MCH, MCHC, RDW
- Peripheral smear
- Clinical details and history of hematinics taken from medical record department (MRD
- Literacy rate and socioeconomic status taken from MRD

Table 1 showing normal RBC indices

Indices	Method of calculation	Normal value
MCV(mean corpuscular volume)	PCV(100mlblood/RBC count(million/cumm)x10	90µm3(78-94µm3)
MCH(mean corpuscular hemoglobin)	Hb(gm%)/RBC(million/cumm)x10	30pg(28-32pg)
MCHC(mean corpuscular hb concentration)	Hb(gm%)/PCV(100 ml blood)x100	33%(35±3%)

Hemoglobin percent, PCV, Red blood cell indices were collected by running anticoagulated blood in automated haematology analyser. Peripheral smear is prepared by manual spreading and stained by using Leishman's stain.

Results

Out of 205 patients, 80(39.1%) were clinically diagnosed as iron deficiency anemia followed by 43(20.9%) as dimorphic anemia, 37(18.1%) Normocytic Normochromic anemia, 45(21.9%) as normal blood picture, in peripheral smear and complete blood counts.

Iron deficiency anemia was the most common disease group in the present study followed by dimorphic anemia and lastly Normocytic Normochromic anemia. Particularly iron deficiency anemia was more prevalent among patients.

Table: 2 proportion of anemia in our study N=205

Anemic status	n(%)
Anemia	160(78%)
No anemia	45(22%)

Table: 3 Types of disease group studied

Table 3 signifies that Iron deficiency anemia was the most common disease group in the present study followed by dimorphic anemia

S no	Type of disease group studied	No of patients	Percentage
1	Iron deficiency anemia	80	39%
2	Dimorphic anemia	43	21%
3	Normocytic Normochromic anemia	37	18%

Table 4 Distribution and severity of anemia among Primi and Multigravida

Parity	Severe	Moderate	mild	Total
Primigravida	10(24.3%)	20(48.7%)	11(26.8%)	41
Multigravida	24(20.1%)	87(73.1%)	8(6.72%)	119
Total	34(21.25%)	107(66.87%)	52(32.5%)	160

Table 4 shows that maximum no. of patients were having moderate anemia with 66.87%

Table 5: Age distribution of anemia based on disease group

Disease group	19- 22	23-25	26-28	29-32	>32
Iron deficiency anemia	13(16.25%)	14(17.5%)	24(30%)	16(20%)	13(16.25%)
Dimorphic anemia	5(11.62%)	9(20.9%)	14(32.55%)	7(16.27%)	8(18.6%)
Normocytic Normochromic anemia	11(29.72%)	8(21.62%)	12(32.43%)	2(5.40%)	3(8.1%)
Normocytic Normochromic blood picture	22(48.88%)	19(42.24%)	4(8.88%)	0	0

Table 5 signifies that most common anemia seen is iron deficiency anemia between age group of 26-32 years

Table 6: Age wise distribution of patients in two groups

Age Group(yrs)	Anemic	Non- Anemic	χ2-value	p-value
19-22 yrs	29(18.13%)	22(48.89%)	27.42	0.0001,S
23-27 yrs	81(50.63%)	23(51.11%)		
28-32 yrs	26(16.25%)	0(0%)		
≥33 yrs	24(15%)	0(0%)		
Total	160(100%)	45(100%)		
Mean ± SD	27.18±4.69	23.04±1.69		
Range	20-42 yrs	20-27 yrs		

Table 6 this table signifies that as age advances chances of pregnant women to become anemic increases.

Table 7: Parity wise distribution of patients in two groups

Parity	Anemic	Non- Anemic	χ2-value	p-value
Para 1	41(25.63%)	27(60%)	27.13	0.0001,S
Para 2	47(29.38%)	15(33.33%)		
Para 3	48(30%)	3(6.67%)		
Para 4	17(10.63%)	0(0%)		
Para 5	6(3.75%)	0(0%)		
Para 6	1(0.63%)	0(0%)		
Total	160(100%)	45(100%)		

This table signifies that primipara, para 2 and para 3 have maximum no. of anemic cases due to low socio economic status and lesser birth gap.

Table 8: Comparison of Hb% in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	8.28	1.34	0.10	15.70	0.0001,S
Non Anemia	45	11.44	0.21	0.03		

Table 8 signifies that hb% show significant changes in case of anemia with mean of 8.28± 1.34SD

Table 9: Comparison of HCT in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	26.23	4.54	0.35	14.69	0.0001,S
Non Anemia	45	36.80	3.05	0.45		

Table 9 signifies that hematocrit value is lower in anemic person than non anemic person with mean of 26.23± 4.54SD

Table 10: Comparison of RBC count in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	3.30	0.54	0.04	6.49	0.0001,S
Non Anemia	45	3.84	0.18	0.02		

Table 11: Comparison of MCV count in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	70.40	8.58	0.67	8.27	0.0001,S
Non Anemia	45	81.08	1.85	0.27		

This table signifies that non anemic pateint have high MCV values in comparison to anemic one with mean of 70.40±8.58SD.

Table 12: Comparison of MCH count in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	23.11	3.00	0.23	6.29	0.0001,S
Non Anemia	45	26.35	3.25	0.48		

Table 12 signifies that MCH values in anemic patient with mean of 23.11± 3SD

Table 13: Comparison of RDW Level in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	20.88	3.41	0.27	12.35	0.0001,S
Non Anemia	45	14.55	0.65	0.09		

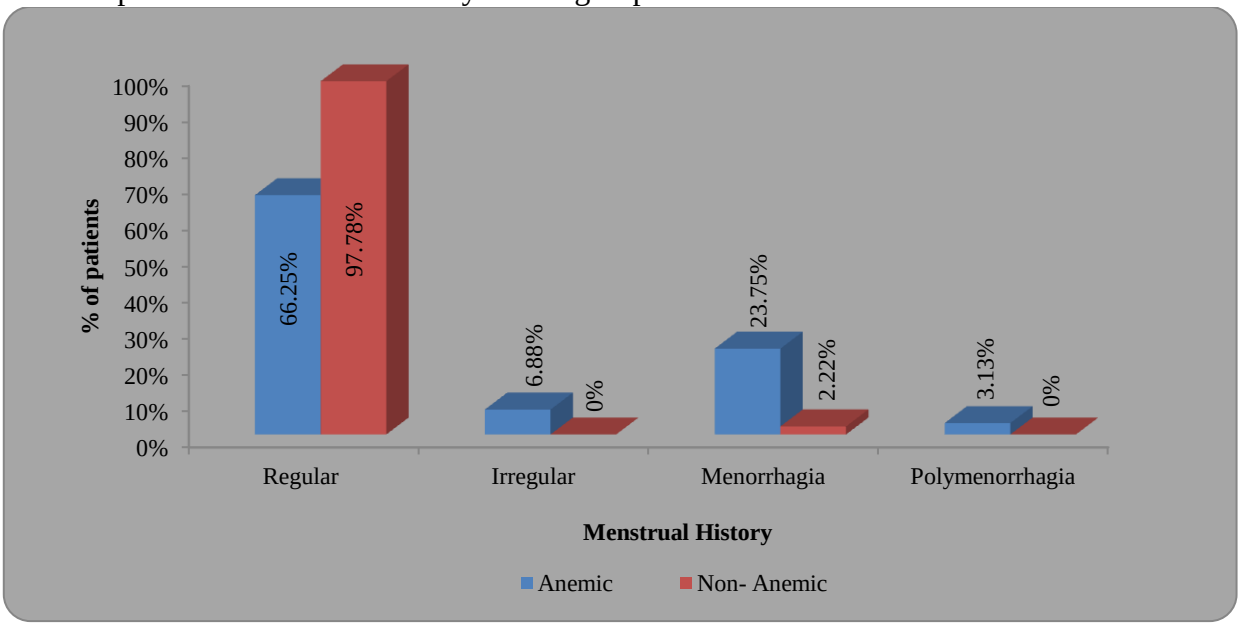
Table 13 shows there is high RDW value in anemic patient comparison to non anemic population with mean of 20.88±3.41SD

Table 14 Comparison of PDW level in two groups
z-test for difference between two means

Group	N	Mean	Std. Deviation	Std. Error Mean	z-value	p-value
Anemic	160	14.06	0.98	0.07	0.77	0.43,NS
Non Anemia	45	14.19	0.93	0.14		

Table 14 signifies Platelet Distribution Width has not much significance in our study

Figure 1: Comparison of menstrual history in two groups



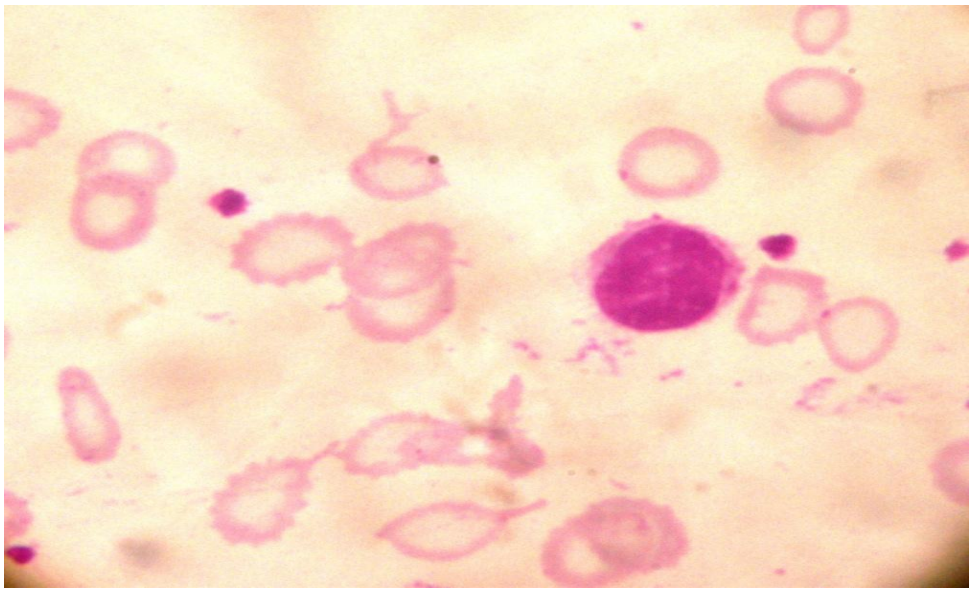


Figure 2: Iron deficiency anemia. Microcytic hypochromic cells (in comparison with small lymphocyte-arrow) with anisopoikilocytosis. Leishman stain 100x.

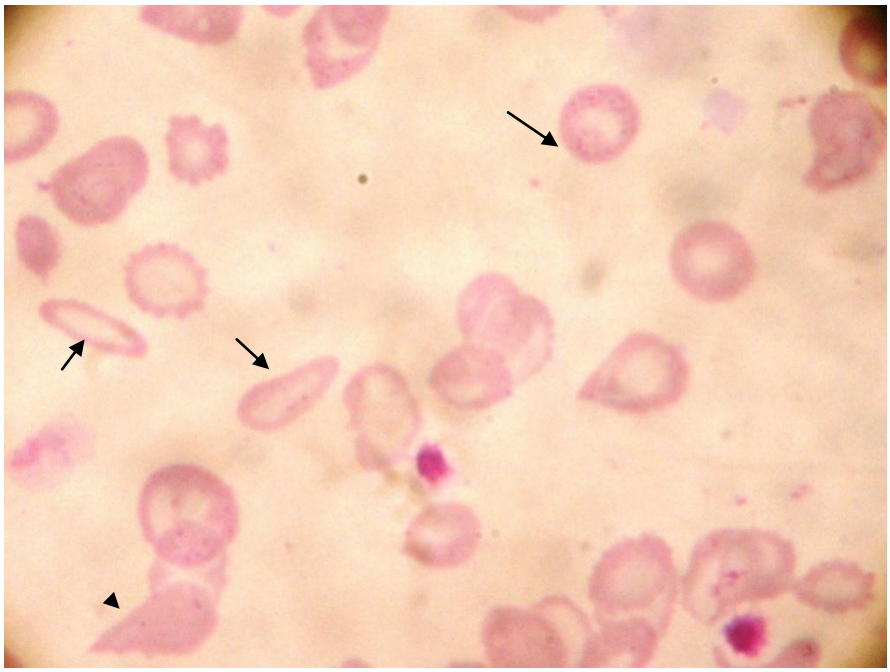


Figure 3: Iron deficiency anemia. Microcytic hypochromic cells with pencil cells (arrow) and teardrop cell (arrow head). Leishman stain 100x.

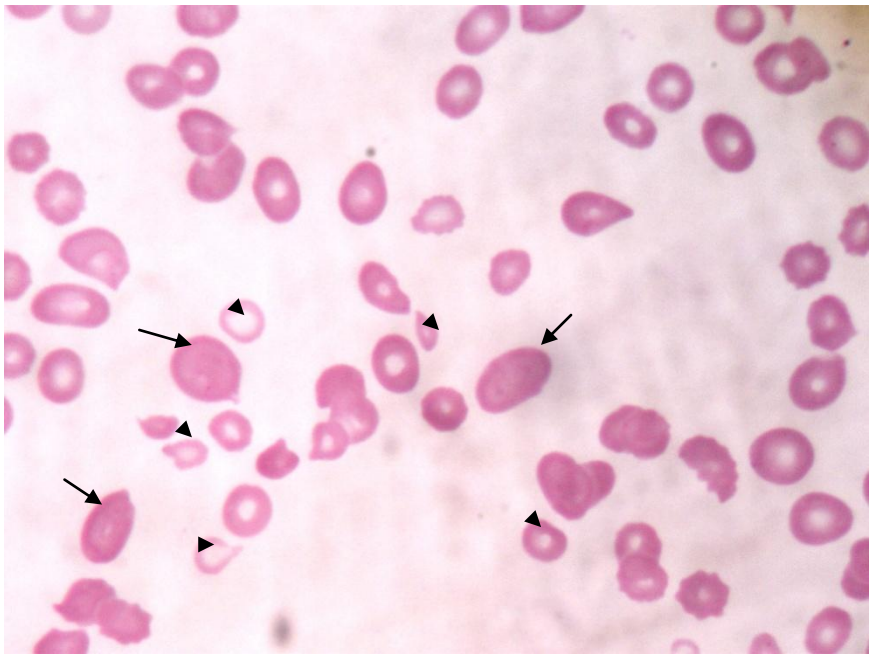


Figure 4: Anemia of liver disease. Macrocytes(arrows) with microcytes(arrow heads). Leishman stain.100x.

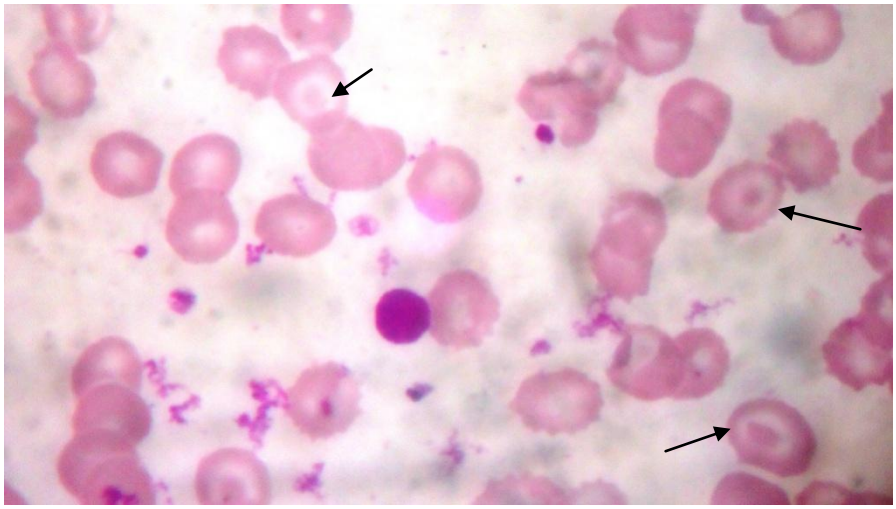


Figure 5: Anemia of liver disease Macrocytic RBC s with target cells (arrows). Leishman stain.100x.

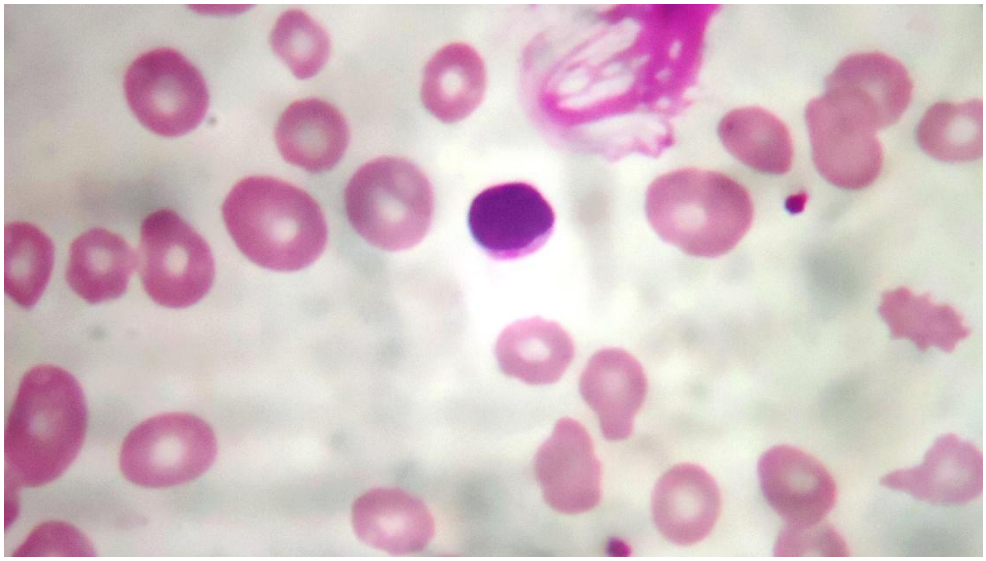


Figure 6: Anemia of liver disease Macrocytic with microcytic RBC s. Leishman stain. 100x.

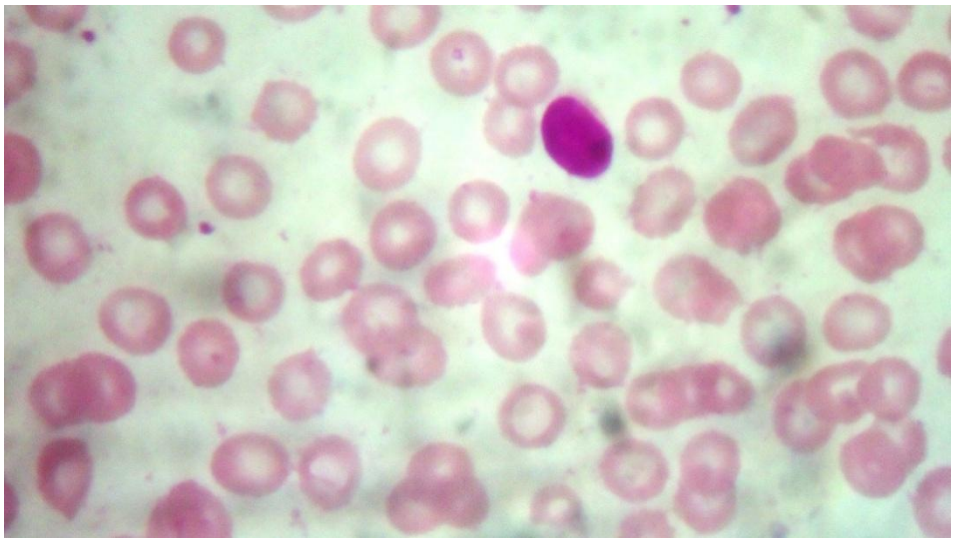


Figure 7: Anemia of Chronic disease Normocytic hypochromic cells. Leishman stain 100x.

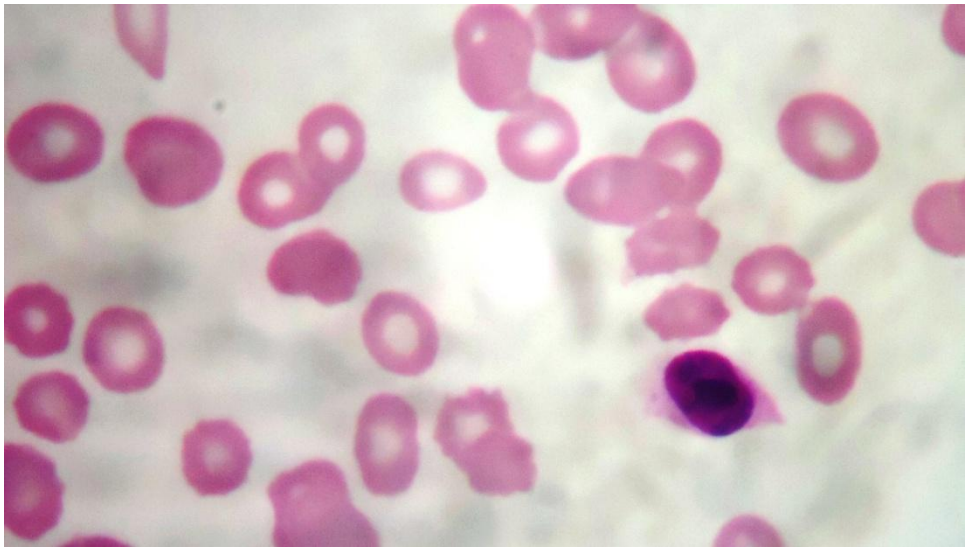


Figure 8: Anemia of chronic kidney disease Normocytic Normochromic anaemia Leishman stain. 100x

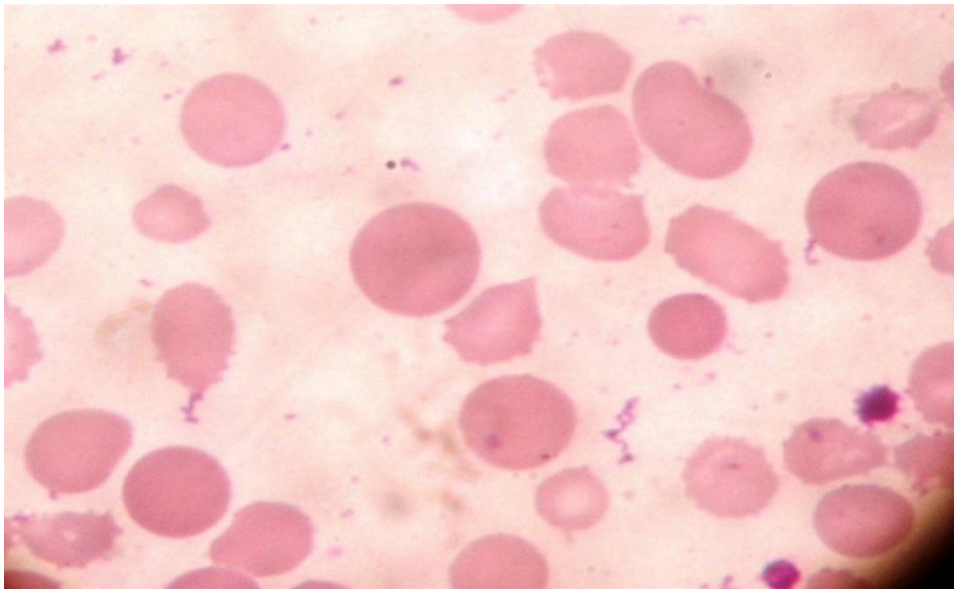


Figure 9: Dimorphic anemia (anemia of combined deficiency), Predominantly macrocytes with microcytes. Leishman stain 100x.

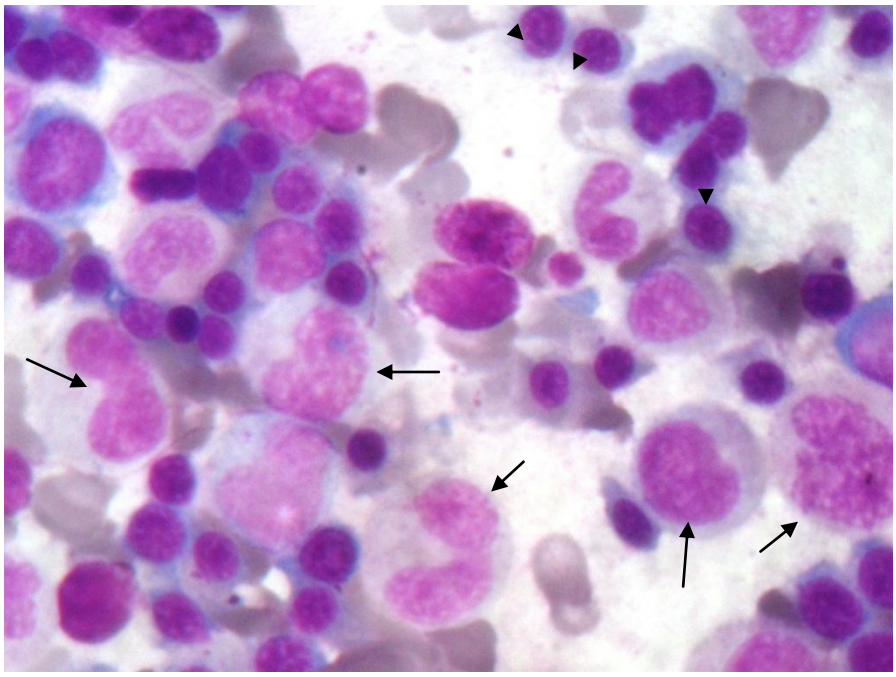


Figure 10: Bone marrow of dimorphic anemia (anemia of combined deficiency), Megaloblasts and giant metamyelocytes (arrows) with micro normoblasts (arrow heads). Leishman stain.100x.

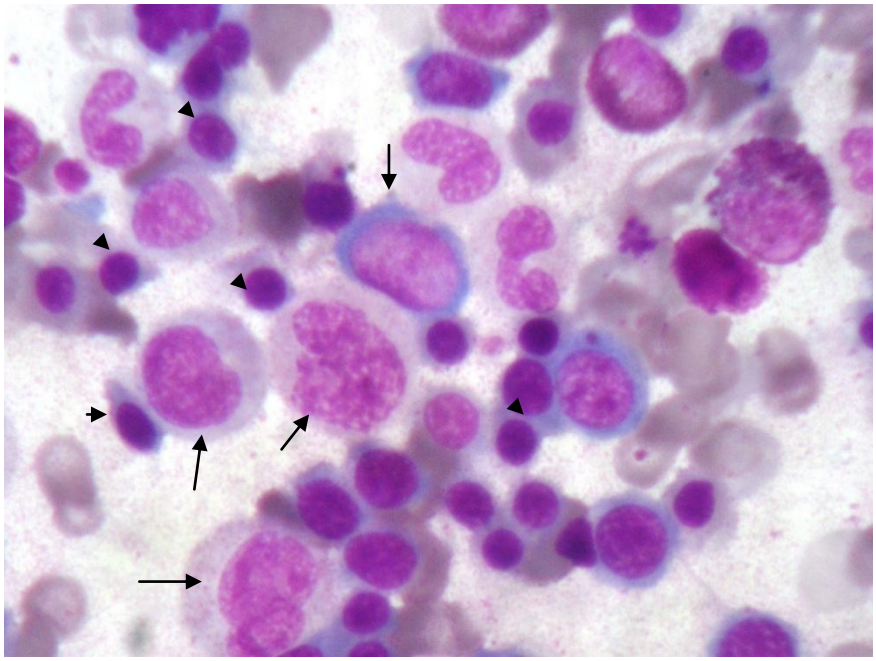


Figure 11: Bone marrow of dimorphic anemia (anemia of combined deficiency), Megaloblasts (arrows) and micronormoblasts (arrow heads). Leishman. stain 100 x.

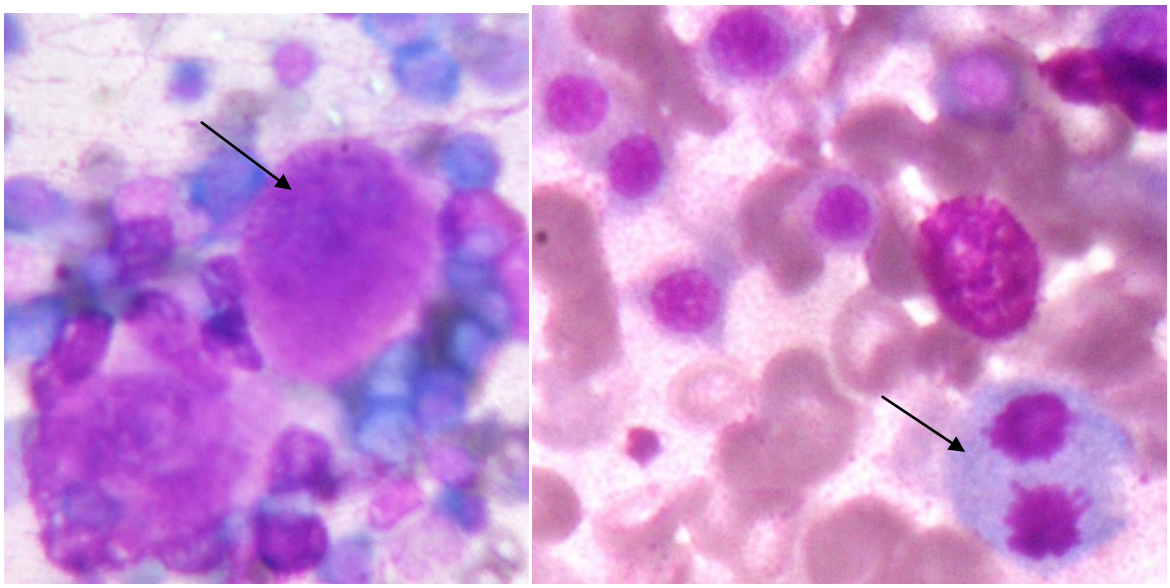


Figure 12: Bone marrow of dimorphic anemia (anemia of combined deficiency), Micromegakaryocytes and abnormal mitosis. Leishman stain.100x.

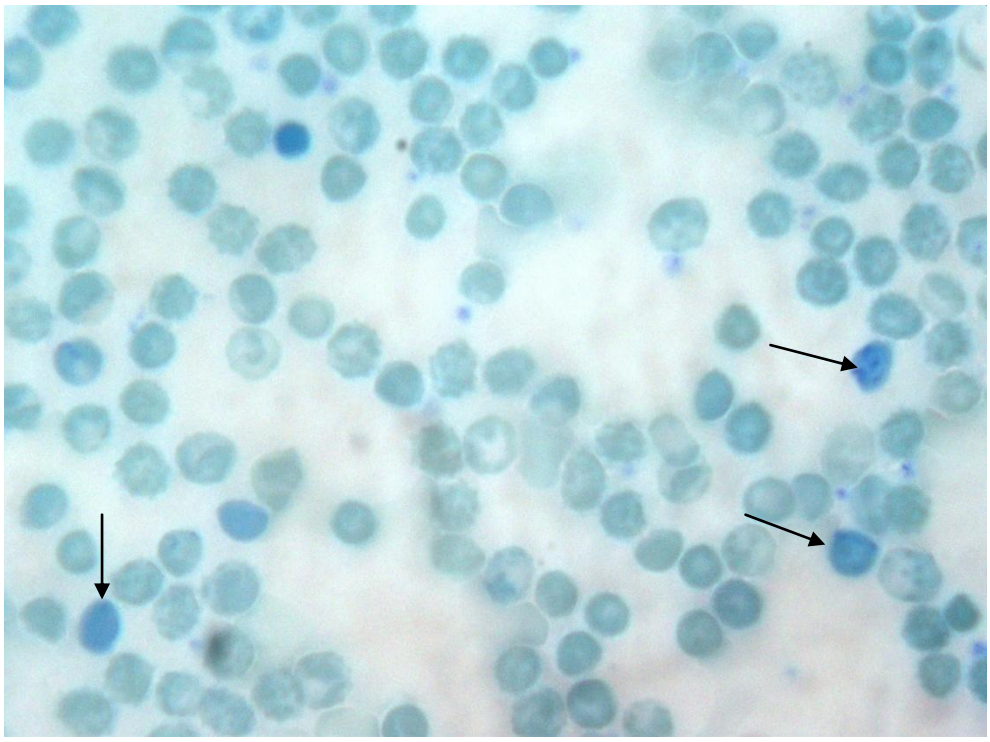


Figure 13: Increased reticulocyte count. New methylene blue stain.100x.

Discussion

In the present study 205 patients with anemia who came for antenatal check up were reviewed by using haematological parameters and subdivided into different disease groups. Out of 205 patients 80(39%) were clinically diagnosed as iron deficiency anemia (IDA) followed by 43(21%) as dimorphic anemia, 37(18%) as Normocytic Normochromic anemia , and remaining 45(22%) as Normocytic Normochromic blood picture.

Iron deficiency anemia was more prevalent in the age group of 31-42, followed by age group of 25-30. Dimorphic anemia was also more prevalent in the age group of 25-36 years. Normocytic Normochromic Anemia was most commonly seen in the age group of 21-25 years & the Normocytic

Normochromic blood picture seen most comm.- only in age group of 21- 27 years old female.

Iron deficiency anemia: In this study increased iron loss was due to menstrual bleed and hook worm infestations. 39 (19%) patients had clinical documentation of menorrhagia due to various gynecological reasons. Shersten et al[17] observed that menstruating women lose from 0.6 to 2.5 percent more per day and average (60kg) woman might lose an extra 10 mg of iron per menstrual cycle, but the loss could be more than 42 mg per cycle depending on how heavily she menstruates[17].

In the present study in moderate anemia patients, hypochromia was noted and as the severity of anemia increases the hypochromia becomes more severe and greater percentage of erythrocytes were affected. When hypochromia was extreme, most of the red blood cells appear as tiny microcytes and a moderate number of poikilocytes, particularly tear drop and pencil shaped cells, were also found. At this extreme stage of severe anaemia, RDW value decreased as more number of cells were uniformly microcytic[15].

Dual deficiency group might be classified as 1) Iron deficiency anemia complicated by nutritional macrocytic anemia. 2) Nutritional macrocytic anemia complicated by iron deficiency. Since the peripheral blood smear shows two aspects, the bone marrow shows different types of erythropoiesis, and two factors have been detected in its aetiology and the treatment.[18]

The desirable effect with concurrent iron, vitamin B12 and folic acid therapy will be appreciated one week after administration of therapy which can be monitored by the reticulocyte count in younger age group. But in the older patients, degree of improvement after initiation of therapy will be low as the marrow response was poor. Packed red cell transfusion is not always necessary in anemia of combined deficiency, but it is of value in severe grade anemia and in symptomatic anemia patients.

The aim of the present study was to evaluate the hematological changes/variation that occurs during normal pregnancy. The result of the blood hemoglobin showed a significant difference ($P < 0.001$) in all the three trimester between anemic and non anemic group. This finding is also supported by studies done by Good et al and Good W.[22,23] Decreasing levels of hemoglobin throughout the pregnancy might be explained on the basis of a generalized great increase in the plasma volume as compared to hemoglobin and cell volume.

During the third trimester of pregnancy, a highly significant decrease in RBC count from non-pregnant state was observed. This result is also supported by Benson et al and Jain et al.[23]

The difference was statistically significant in our study which was comparable to the findings of Osonuga et al. his agrees with previous work by Luppi, who asserted that a total WBC count rising in early pregnancy will remain elevated through pregnancy. This may be as a result of the body building the immunity of the fetus and it is achieved by a state of selective immune tolerance, immune suppression, and immune modulation in the presence of a strong anti-microbial immunity. There is also down regulation of potentially dangerous T-cell-mediated im-mune responses, while activating certain components of the innate immune system, such as neu-trophils. This unique dysregulation between different components of the immune system plays a central role in the maternal adaptation to pregnancy.

A significant rise in ESR was note during all three trimester of pregnancy. The increased ESR is due to increased plasma proteins especially fibrinogen in the blood which is noted during pregnancy. From our study, it was found that there was a significant difference in the PCV in all three trimester. This finding is in line with those of James et al[16]. The decrease in PCV may be due to increase in plasma volume during pregnancy which causes hemodilution, and increased rate of infection especially malaria, hormonal changes, and conditions that promote fluid retention and iron deficiency.

The slightly lower values of MCV and MCH in control group indicate a borderline case of iron

deficiency anemia. All the subjects in the control group and mild and moderate anemia received Antenatal care and Iron supplementation. Lower values of MCV, MCH and MCHC were found in group not taking iron supplementation compare to that taking iron supplementation was highly significant.

Iron deficiency anemia with gestation is an artefact of the normal physiologic changes of pregnancy. Although the maternal red cell mass and plasma volume both increase during gestation, they do not do so simultaneously. Hemoglobin and hematocrit decline throughout the 1st and 2nd trimesters, reach their lowest point late in the second to early in the 3rd trimester and then rise again nearer to term. It is thus becoming clearer that the best time to detect any risk associated with maternal anemia may be early in pregnancy. Furthermore, this study should be used as an evaluation of pregnancy outcome in relation to maternal hemoglobin concentration. India contributes about 80% of the maternal deaths caused by anemia in south Asia[2]. This study which was conducted in our hospital included 205 antenatal cases from all three trimester, which were booked and were regularly taking iron and folic acid tablets.

According to our study, it was found that 69 % of cases had Hb levels of less than 10 g%. Only 21% had Hb of more than 10 g%, even with intake of iron supplements. Among them, majority were in the age group of 25- 32 years, as was seen in a study conducted by Viveki et al.[19] Moreover, there was a high rate of maternal anemia from age of 28 years onwards and above 33 years of age. WHO recorded that anemia was significantly high in the third trimester of pregnancy than in other two trimesters[20]. Our study also indicated the same.

Health education given to improve the utilization of available facilities and improvement in the health care delivery system to cater to the needy, right at their door steps, may thus go a long way in reducing adverse obstetric outcomes associated with maternal anemia.

Conclusion

It can be concluded that altered hematological indices such as hemoglobin, red blood cell (RBC) count, white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), packed cell volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) are seen during all three trimesters of normal pregnancy.

Anemia in pregnancy is associated with adverse consequences both for the mother and the fetus. Studies have shown that the adverse consequences of maternal anemia may affect not only the neonate and infant but also increase the risk of non communicable diseases when the child grows into an adult and the risk of low birth weight in the next generation. Automated analysers for detection of anemia and its effective treatment are available and affordable and it is possible to effectively implement these even in primary health care settings and these are very cost effective interventions.[19]

The anemia which developed progressively during pregnancy was more severe in women who had lower hemoglobin levels in the 1st trimester. In those who received iron supplementation the fall of Hb was less as compare to those who did not receive iron supplementation. The hematocrit, RBC count and Hb indices were, lower in women who did not receive iron supplementation.

The minimum incidence of preterm birth was noted in association with Hb concentration between 8-10 g/dl. The birth weight of baby has a direct relation with severity of anemia.

So this study confirms that prevalence of anemia increases as the pregnancy progresses and that a normal value at 1st booking in 1st trimester should not be considered sufficient, as further Hb values should be checked during the course of pregnancy which results in better monitoring of pregnancy in the form of early detection of anemia and it correction. This will help to reduce fetal morbidity and mortality. Regular patient education given by imparting proper knowledge regarding

iron rich foods, food fortification, implementation of anemia prophylaxis programmes from adolescence, regular antenatal care from first trimester, play a vital role in managing maternal anemia effectively and for effective perinatal outcomes. All practitioners handling obstetrics cases should be motivated for prescribing iron preparations and balanced diet with good compliance.

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