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Evaluation of Serum Ferritin Levels in Anemic Pregnant Women

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Abstract: This study was conducted on 200 antenatal cases reporting to the department of Obstetrics and Gynaecology of MMIMS&R Mullana, having haemoglobin levels less than 11gm/dl. Study was aimed at the assessment of serum ferritin levels and haematological parameters in anemic pregnant women and to evaluate the degree of severity of anemia including it's morphological types on the basis of peripheral blood film. A panel of haematological investigations was performed that included Hb estimation, RBC count, MCH, MCHC, MCV, PCV, peripheral blood film and biochemical test of serum ferritin estimation respectively. Majority of the antenatal cases (55%), showed microcytic hypochromic blood picture on PBF examination. Serum ferritin levels of <15µg/l were seen in maximum no of cases (92.5%), which was suggestive of iron deficiency. Conclusively, individual haematological parameters have their limitations, so a combination of different parameters certainly improves their usefulness in antenatal care. These parameters should be combined with other tests like serum ferritin levels estimation, to know the exact iron status in pregnancy, as it is an accurate measure of iron stores. It also distinguishes iron deficiency anemia from anemia of chronic disorders.
Keywords: Serum Ferritin, Haematological parameters, Anemia, Pregnancy.

INTRODUCTION

Background

Anemia is characterised by fall in the concentration of circulating haemoglobin or oxygen carrying capacity of blood, below the level, expected for healthy person of same age and sex in the same environment [1].

It is a world-wide problem with highest prevalence in developing countries. It is usually found among pregnant women and lactating mothers [2]. Pregnancy results in hormonal, haemodynamic and haematological changes and anemia is one of the frequent complication related to pregnancy [3]. WHO defined anemia in pregnancy as Hb conc of <11gm/dl in Ist and 3rd trimester and <10.5 gm/dl in 2nd trimester [4]. It has estimated prevalence of anemia in pregnant women as 14% in developed and 51% in developing countries. Factors responsible for high prevalence of anemia in India are dietary deficiency of iron (<20mg/day) and folic acid (<70µg/day), poor bioavailability of iron (3-4%) in phytate, fibre-rich Indian diet and chronic blood loss due to infections like malaria and hookworm infestations. Repeated pregnancies with inadequate spacing and absence of replenishment of iron stores lost during menstruation, also contribute. Moreover, maternal anemia is often linked with increased risk of maternal and foetal morbidity and mortality. Poor iron stores at birth, low iron content of breast milk and low dietary intake of iron during infancy and childhood, also result in high prevalence of anemia. It gets further aggravated, due to increased requirements during antenatal period and adolescence [5]. Centre for disease control and prevention explains anemia in pregnancy as Hb levels <11g/dl during I^{st} and III^{rd} trimesters and <10.5g/dl during II^{nd} trimester. A Hb level <11g/dl at any time during period of gestation is also used as a cut off point for anemia in consideration of patients with uncertain or inaccurate pregnancy dating [6].

Pregnant women are more susceptible to anemia as compared to non- pregnant women, because of increase in blood volume by about 50% with a corresponding increase in red cell mass of only 18%. Consequently, Hb level further decreases due to hemodilution. It normally falls progressively from the end of 12^{th} week of pregnancy until 34-36^{th} weeks & returns to previous level in 6-8 weeks post-partum. This is regarded as physiological anemia of pregnancy [7]. In

pregnancy, anemia has a significant impact on health of the fetus and mother. Fetus is at a greater risk of preterm delivery, low birth weight, morbidity and perinatal mortality due to impairment of oxygen delivery to placenta and fetus [8, 9]. It is a startling fact that, about half of global maternal deaths due to anemia occur in South Asian countries, to which India contributes about 80%. Thus, routine screening tests for anemia are strongly recommended [10, 11].

AIM & OBJECTIVES

To assess Serum ferritin levels & Haematological parameters (Hb, RBC count, MCV, MCH, MCHC, PCV and PBF) & to grade degree of severity of anemia and it's morphological types in pregnant women.

MATERIAL AND METHODS

This prospective study included 200 antinatal cases having Hb levels <11g/dl, and undertaken to evaluate their serum ferritin levels and haematological parameters including PBF. The degree of severity of anemia was graded, according to W.H.O criteria, from mild, moderate to severe and Hb levels for each of these types of anemia were taken as 10.0-10.9gms/dl as mild, 7.0-9.9gms/dl as moderate and <7gms/dl, as severe degree respectively. The cut off value for serum ferritin level was taken as 15µg/l [12].

Ethical consideration

The study was approved by instituitional Ethical Committee.

Inclusion Criteria

- Pregnant women attending OPD at their first hospital visit and having Hb levels less than 11gm/dl.
- Pregnant women belonging to age group between 19-35 yrs.

Exclusion Criteria: Maternal infections.

Statistical analysis

The completed questionnaire was checked regularly during data collection to rectify any discrepancy, logical errors or missing information.

RESULTS

This analytical study was carried out in the department of Pathology, on total of 200 anemic pregnant women having Hb level < 11gm/dl, attending OPD of Obstetrics. All the parameters like serum ferritin values, haematological parameters and morphological types of anemia were assesed respectively.

Table-1: Age wise distribution of anemic pregnant women

Age group (yrs)	No of patients	%age
<19	03	1.5%
20-25	170	85%
26-30	19	9.5%
31-35	08	4%
Total	200	100 %

Three patients were of <19yrs of age, 170 cases between 20-25yrs, 19 cases between 26-30 yrs and 8 cases belonged to 31-35yrs of age respectively. Out of total, 110(55%) women were primigravida and 90(45%) as multigravida.

Table-2: Trimester wise distribution of anemic pregnant women

Trimesters	No. Of Patients	%age
1st trimester	22	11%
2nd trimester	62	31%
3rd trimester	116	58%
Total	200	100%

22/200 cases were in first trimester, while 62 and 116 cases were in second and third trimesters respectively. Majority of patients, presented with chief complaints of pallor (56%), followed by generalised weakness (16%), dyspnea (14%), Pedal oedema (12%) and fever in 4 cases (2%) respectively.

Table-3: Distribution according to degree of severity of anemia

Degree of Anemia	No of Patients	%age
Mild A (10.0-10.9gm/dl)	56	28 %
Moderate A (7-9.9 gm/dl)	110	55 %
Severe A (<7 gm/dl)	34	17 %
Total	200	100

It was observed that 28% of women had mild anemia, 55% as moderately anemic, while 17% were severely anemic, based on W.H.O criteria. Red blood cell counts were within normal limits in 62cases (31%), 2 cases (1%) were having increased RBC counts, while 136 cases (68%) had RBC count below normal range.

Table-4: Age group wise haematological profiles (mean values)

Age group(yrs)	No of patients	Hb_{gms} /dl	RBC 10^3/µl	PCV(%)	MCV(fl)	MCH (pgm)	MCHC (gms/dl)
<19	03	9	3.23	30.2	83	27.5	29.3
20-25	170	8.2	3.59	28.9	79.1	27.0	29.8
26-30	19	8.2	3.35	31.5	82.1	27.2	29.3
31-35	08	8.5	3.76	31.1	86	26.7	29.8

Table-5: Morphological types of anemia in women

Type of anemia	No of patients	(%) age
Microcytic & Hypochromic	110	55%
Normocytic & Hypochromic	60	30%
Normocytic & Normochromic	08	4%
Microcytic & Macrocytic (Dimorphic)	15	7.5%
Macrocytic	07	3.5%
Total	200	100%

Haematological parameters were out of normal range in all age groups.

Five morphological types of anemia were seen in anemic pregnant women. The commonest was microcytic & hypochromic type consisting of 110 cases followed by 60 cases of normocytic & hypochromic type and 8 cases of normocytic & normochromic, 15cases of microcytic & macrocytic anemia (Dimorphic) followed by 7 cases of macrocytic anemia repectively.

Table-6: Distribution of serum ferritin levels

Serum Ferritin levels(µg/l)	No. Of Patients	%age	Interpretation
<15µg/l	185	(92.5%)	Iron deficiency
15-30µg/l	7	(3.5%)	Initial sign of depleting iron stores
30-45µg/l	0	-	-
45-60µg/l	0	-	-
60-75µg/l	0	-	-
75-90µg/l	0	-	-
>90µg/l	8	(4%)	Excludes I deficiency

Out of total cases, 185 patients were having ferritin levels<15µg/l followed by 7cases having 15-30µg/l, whereas only 8 cases were having serum ferritin levels >90µg/l. This excluded the possibility of iron deficiency.

Table-7: Serum ferritin conc in different trimesters (mean)

Serum Ferritin (µg/l)	1st trimester	2nd trimester	3rd trimester
Mean	25.76	11.64	7.86
No. of Patients	22	62	116

Serum ferritin concentration was highest in pregnant women of first trimester with a mean of 25.76µg/l, 11.64µg/l in 2nd trimester and lowest in women of third trimester with a mean value of 7.86µg/l.

Table-8: Statistical analysis of serum ferritin levels in different trimesters

Trimesters of pregnancy	No of patients	Mean	Std. Deviation
1st	22	25.768182	35.5260654
2nd	62	11.596452	15.7621146
3rd	116	7.868103	12.7695807
Total	200	10.992900	18.2623850

Groups	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5958.047	2	2979.023	9.715	.000
Within Groups	60411.379	197	306.657		
Total	66369.426	199			

Result- P value <0.001(Highly significant)

Table-9: Serum ferritin conc in different morphological types of anemia

		Microcytic hypochromic anemia	Macrocytic Anemia	Dimorphic anemia	Normocytic hypochromic	Normocytic normochromic anemia
Serum ferritin conc(µg/l)	Mean	5.0	19.52	11.6	8.46	98.27
	No. Of Patients	110	7	15	60	8

Serum ferritin concentration in microcytic hypochromic anemia was lowest with a mean value of 5.0µg/l and highest in normocytic normochromic anemia with a mean of 98.27µg/l.

Table-10: Morphological classification of anemia, S ferritin assay and PBF details

No of Patients	**%age**	**PBF details**	**Serum Ferritin Assay**	**Diagnosis**
110	55%	Predo MHC blood picture,mod anisopoikilocytosis, pencil and target cells.	Conc < 15µg/l	IDA
60	30%	Predo NHC with mild anisopoikilocytosis	Conc <15µg/l	NHC, A
8	4%	Predo NNC with seve anisopoikilocytosis	Conc > 90µg/l	Anemia of ch disorder
15	7.5%	Micro&macrocytes, mild to mod hypochromia with ovalocytes.	Conc < 15µg/l	Dimorphic A
7	3.5%	Predo macrocytic picture, Ovalocytes, hypersegmented polymorphs, with mod anisopoikilocytosis.	Conc > 15 µg/l	Macrocytic A

Table-11: Age group wise distribution of anemic women

Studies	Total no of cases	Age group	Results
Shah *et al*., (2012) [13]	51	>20 yrs 20-25 yrs 26-30 yrs 31-35 yrs	3.9% 51% 33.1% 12%
Sharma *et al*., (2013) [14]	100	20 yrs 20-25 yrs > 25 yrs	7% 63% 30%
Olantunbosun *et al*., (2014) [15]	400	<20 yrs 20-24 yrs 25-29 yrs 30-34 yrs 35-39 yrs >40 yrs	0.8% 14.3% 41.3% 32.3% 10.5% 1%
Present Study	200	<19 yrs 20-25 yrs 26-30 yrs 31-35 yrs	1.5% 85% 9.5% 4%

Table-12: Comparative distribution of anemic women according to parity

Studies	Total no of cases	Results	
		Primigravida	Multigravida
Shah *et al*., (2012) [13]	51	45%	55%
Sharma *et al*., (2013) [14]	100	45%	55%
Present study	200	55%	45%

Table-13: Comparative analysis and trimester wise distribution of women

Studies	Total no of cases	Results		
		I Trimester	II Trimester	III Trimester
Shawi *et al*., (2012) [16]	236	19.49%	29.23%	51.28%
Olantunbosun *et al*., (2014) [15]	400	8.25%	62.75%	29%
Present study	200	11%	31%	58%

Table-14: Comparative evaluation of Haematological parameters in different age groups.

Studies	Total no of cases	Age groups	Haematological parameters (mean values)				
			RBC count	MCV	MCH	MCHC	PCV
Sharma *et al*., (2013) [14]	100	20 years	3.52	77.79	21.17	27.42	29.43
		20-25years	3.78	79.49	24.47	27.67	31.24
		>25 years	3.56	76.23	23.03	28.04	32.20
Debalina *et al*., (2014) [17]	80	20 years	9.56	79.49	27.67	24.47	-- -
		20-25years	8.10	77.79	27.42	21.17	- - -
		>25 years	8.15	78.23	28.42	23.43	- - -
Present study	200	<19 years	3.23	83	27.5	29.3	30.2
		20-25 years	3.59	79.1	27.0	29.8	28.9
		26-30 years	3.35	82.1	27.2	29.3	31.5
		31-35 years	3.76	86	26.7	29.8	31.1

Table-15: Comparative analysis of degree of severity of anemia

Studies	No. of cases	Results		
		Mild Anemia	Mod A	Sev A
Ugwuja *et al*., [18]	300	30%	67%	3%
Sinha *et al*., [19]	364	68.60%	29.06%	2.32%
Singh *et al*., [20]	512	67.14%	28.57%	4.29%
Present study	200	28%	55%	17%

Table-16: Comparative assessment of Morphological types of anemia

Studies	Total no of cases	Results				
		Microcytic Hypochromic	Normocytic Hypochromic	Normocytic normochromic	Dimorphic	Macrocytic
Dorothy *et al*., [21]	239	64.9%	-	-	34.7%	0.4%
Ivan *et al*., [22]	75	37%	27%	-	19%	17%
Melku *et al*., [23]	50	16%	4%	76%	-	4%
Study	200	55%	30%	4%	7.5%	3.5%

Table-17: Comparative analysis of Serum ferritin levels in different trimesters

Studies	Total no. of cases	Serum ferritin levels (mean)		
		I Trimester	IITrimester	IIITrimester
Asif *et al*., (2007) [24]	150	26.62	11.35	20.42
Abel R *et al*., (2001) [25]	90	16.20	13.70	52.82
Present study	200	25.76	11.64	7.86

DISCUSSION

Out of total anemic pregnant women, majority of anemic cases were primigravida, in the early age group of 20-25 yrs. They presented with chief complaints of pallor (56%), followed by generalised weakness in 32 cases, dyspnoea in 28 cases, pedal oedema in 24 cases and fever in 4 cases, respectively. After completion of haematological investigations, it was noticed that maximum no of cases (55%) were having moderate degree of anemia and haematological indices in all the age groups fell below the normal range. Serum ferritin levels consistently decreased with progression of pregnancy, showing lowest mean values in women during third trimester of pregnancy and majority of cases (92.5%) showed ferritin levels <15µg/l, indicating iron deficiency, whereas 4% of cases showed higher ferritin levels (>90µg/l).

Pregnancy is a physiological cause of stress due to many anabolic changes taking place during accomplishment of fetal growth. Anemia is one of the frequent complication of pregnancy. All women during child bearing age are prone to develop iron deficiency, but pregnant ones are especially at higher risk due to low dietary intake, work load and nutritional deficiencies including iron, folate and ascorbic acid

making Indian women more susceptible to anemia and illness.

Our study indicated that maximum no of cases (85%) presented in the early age group of 20-25 yrs, which is in concordance with the studies by Shah *et al*., [13] and Sharma *et al.*, [14], but in a study by Olantunbosun *et al*., [15], maximum number (41.3%) of anemic cases among pregnant women were seen in the higher age group ie (25-29 yrs), which is discordant with our study. This is because, in our country, early marriage continues to be a common cultural norm, leading to early motherhood and anemia due to poor nutritional status of the mother during the period of adolescent growth spurt.

In this study, majority of the anemic cases were primigravida. It is discordant with the studies by Shah *et al*., and Sharma *et al*., in which maximum no of cases were multigravida (55%). In their studies, multiple pregnancies was one of the main etiological factors for anemia, but in our centre, we mainly cater rural population usually having low standard of living, low socioeconomic status and lack of awareness regarding importance of antenatal care. These women present themselves as anemic even in their first pregnancy [13, 14].

Table-13 shows, maximum no of anemic cases presented in third trimester, which is in concordance with the study by Shawi *et al*., [16], but discordant with the study by Olantunbosun *et al*., Here in, pregnant women commonly suffer from physiological anemia throughout their antenatal period, which gets further aggravated in the last trimester, due to increased demands of fetus and non-compliance to haematinics during pregnancy.

In this study, haematological parameters of anemic pregnant women in all age groups were below the normal values, thus corroborating with the studies by Sharma et al and Debalina *et al*., [17]. As anemia is quite common among pregnant women, lactating mothers and adolescents in our country. Prevalence rate being 65-75% is due to several etiological factors like dietary deficiency of iron and folic acid, poor bioavailability of iron in phytate, fibre-rich Indian diet and chronic blood loss due to infections like malaria and hookworm infestations.

In our study, maximum number of cases (55%) were moderately anemic on the basis of W.H.O criteria and it is corroborating with study by Ugwuja *et al*., [18], but discordant with the studies by Sinha *et al*., [19] and Singh *et al*., [20], because these studies used different criteria (ie other than W.H.O) for categorising the antenatal cases according to degree of severity of anemia.

Microcytic & hypochromic anemia was the commonest morphological type in the study, usually seen in the cases of iron deficiency. Iron deficiency anemia (IDA) is a global health problem, which is highly prevalent among women in developing countries. In addition to being an independent risk factor for decreased quality of life, IDA in pregnancy is also associated with adverse outcome.

WHO indicates that IDA is a significant health problem throughout world ranging from 1% in industrialized countries to an average of 56% (ranging from 35-75%) in developing countries. In present study, occurrence rate was found to be 55%, which is in concordance with study by Dorothy *et al*., [21] and Ivan *et al.*, [22]. They also found IDA as the commonest type, accounting for 64.9% and 37% respectively. In another study by Melku *et al*., [23] maximum number of cases (76%) showed normocytic normochromic type of blood picture, which is discordant with our study.

In present study, mean serum ferritin levels were consistently found to decrease with progression of pregnancy, due to poor compliance to iron and folic acid supplements during pregnancy. These results were proved statistically highly significant (P value<0.001), but it is disconcordant with the studies by Asif *et al*., [24] and Abel R *et al*., [25], that reported high ferritin levels in cases of third trimester pregnancy.

Analytically, serum ferritin levels were proved useful in distinguishing cases of IDA from anemia of chronic diseases. Out of the total antenatal cases, 92.5% were having serum ferritin levels <15µg/l (IDA), whereas only 4% were having serum ferritin levels above 90µg/l (anemia of chronic disease) repectively. This showed concordance with studies by Alper *et al*., [26] and Wians *et al.*, [27], that also concluded that serum ferritin level is one of the most valuable investigation for arriving at a diagnosis of IDA and differentiating it from anemia of chronic disease.

In our study, anemia was classified on the basis of peripheral blood film and serum ferritin assay, mean ferritin concentration was 5µg/l in microcytic hypochromic anemia, which is suggestive of IDA, 19.52µg/l in macrocytic anemia, 8.46µg/l in normocytic hypochromic, suggestive of depleted iron stores and 98.27µg/l in normocytic normochromic anemia, suggestive of anemia of chronic disease. This is in concordance with study by Sharma *et al*., that also investigated different types of anemia on the basis of PBF and serum ferritin levels [14].

Diagnosis of anemia is difficult to establish on the basis of clinical picture alone. It is important to initiate therapy early, because of high mortality associated with anemia in pregnancy. Haematological profile is a simple, fast and cost effective means for diagnosing anemia in pregnancy. However, it has also got its limitations as Hb estimation, PCV and RBC

count remain unreliable during pregnancy due to physiological anemia of pregnancy and it is not helpful in diagnosing it's type. Therefore, this study was designed to determine the combination of haematological parameters along with PBF examination and biochemical test like serum ferritin estimation to find out total body iron stores & to distinguish cases of IDA from anemia of chronic disorders.

CONCLUSION

Anemia is a silent killer, so there is an urgent need to diagnose anemia at an early stage of antenatal period. In essence, individual diagnostic tests have their limitations, a combination of different tests certainly improves their usefulness in antenatal care. Therefore, haematological parameters should be combined with the serum ferritin levels, irrespective of its cost factor to know the exact iron status in pregnancy. This will help to start early management of anemia and strictly during pregnancy for better Obstetrical outcome.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2008.

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