Original Article

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Hematological Profile of Pregnant and non Pregnant females: A comparative Study in a Tertiary Care Hospital in Faridabad, Haryana

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ABSTRACT

Background: There are marked variations in the various haematological parameters during the pregnancy and also during the different trimesters of pregnancy. Due to paucity of literature on the haematological profile of pregnant population in Haryana, India the present study aims to fill the gap by drawing a comparison between cases and controls for the different haematological indices among patients attending a tertiary care hospital and also highlight the difference among the pregnant women across the three trimester(s).

Methods: A case control study was conducted to study and compare the haematological profile among 119 pregnant and 119 non-pregnant women attending the out-patient department of ESIC medical, college & hospital Faridabad,a tertiary care hospital in Faridabad district of Haryana. Statistical analysis of the data was done using SPSS software 17.0. Unpaired students t-test was applied to compare various haematological parameters between cases and controls. One way Anova was applied and Tukey and Games Howell post hoc test was applied to study between group and within group differences among the three trimester with hematological indices.

Result: White blood cells (WBCs), neutrophils, nucleated Red Blood Cells(NRBC), immature granulocytes(IG) and Red cell Distribution Width-Standard deviation (RDW-SD) were found to be higher among cases as compared to controls. Hemoglobin, hematocrit, mean corpuscular volume(MCV),mean corpuscular haemoglobin(MCH), lymphocyte and platelet count were found to be significantly higher among controls as compared to cases. On one-way ANOVA a statistically significant difference in hemoglobin, hematocrit, WBCs, neutrophils, lymphocytes, immature granulocytes and nucleated RBC's was found between the three trimester(s).

Conclusion: Haemoglobin and haematocrit and platelets showed a fall while WBCs and neutrophils showed a rise when compared to the nonpregnant state.The findings of the study will be a value addition in comparative analysis of studies between pregnant and non-pregnant females.

Keywords: Hematological Indices, Pregnancy, Trimester, Case-Control

Introduction

Haematological profile of an individual is a reflection of general state of body and is of significance. It is quick, cheap and easy to perform and reliable.[1] Pregnancy is a physiological condition with profound effects on various organ systems of the body. It is a state of adaptation to meet the increased requirements of fetoplacental unit. There is a marked variation in the haematological profile during pregnancy. Many studies have shown that haematological profile of an individual is a major determinant affecting the pregnancy and its outcome.[2,3,4] Normally in the absence of co-morbidity associated with pregnancy the body can recover, however in the presence of abnormal coagulation states, anemia, hypertension, haemorrhage etc. the parameters remain deranged. Pregnancy is influenced by many factors which includes socioeconomic, enviornmental and cultural conditions which impact the nutritional state of an individual.[5] It is essential for the health care workers to be aware of both normal and abnormal changes during pregnancy and the resulting lab values.[6] This study was undertaken to determine the haematological profile of patients attending tertiary care hospital in Faridabad district of Haryana. This present study evaluates various haematological parameters including haemoglobin (Hb), packed cell volume (PCV), red cell indices, white blood cell (WBC) counts, red blood cell (RBC) counts, RDW, nucleated red blood (NRBCs) and platelet count among normal pregnant women and their comparision with normal control and also study the inter-trimester variation among these parameters.

Materials and Methods:

A case control study was conducted in Department of Pathology in collaboration with Department of Gynaecology at ESIC Medical College & Hospital,

Faridabad among pregnant women attending the out-patient antenatal clinic of the hospital to compare the haematological indices of pregnant and non-pregnant women and to evaluate the haematological parameters of these pregnant women at different trimesters. The study was conducted over a period of three months.119 pregnant women in first, second and third trimester, irrespective of their gravidae, were selected for the purpose of study using convenient sampling and were classified as 'cases'. 119 non-pregnant women attending the out-patient department of the ESIC medical college & hospital were selected and classified as 'controls'. Matching was not done. 4 ml of venous blood was collected in ethylene diamine tetra acetic acid (EDTA) vial. CBC was done using automated sysmex analyser XN 1000 in the central lab of the hospital. Ethical clearance was obtained from the Institutional ethical committee. Any coagulation abnormalities, hypertension, diabetes, respiratory diseases, cardiac, renal and/or haemolytic diseases that alters the test result were excluded from the study. Informed consent was taken from all the participants. Subsequently haematological profile of the patients were studied which is also a part of their routine investigation. The information thus collected was converted into a computer based spreadsheet using Microsoft Excel software. Statistical analysis of the data was done on the Statistical Package for the Social Sciences [SPSS, Chicago, IL] software 17.0. Unpaired student t-test was applied to compare hemoglobin, hematocrit, red cell indices, total WBC count, differential, nucleated RBC's, immature granulocytes and platelet count between cases and controls. One way Anova was applied to study association of haematological indices between three trimester and Tukey and Games Howell post hoc test was applied to study within group differences among the three trimester with haematological indices. p value of 0.05 was taken to be statistically significant.

Result

The number of patients in first, second and third trimester were 38.6%, 31.9% and 29.4% respectively. The mean of various haematological parameters is reflected in Table 1. On applying t-test, hemoglobin was found to be higher among controls as compared to cases and this was found to be statistically significant (p=0.009). Similarly, hematocrit was found to be higher among controls as compared to cases and this was found to be statistically significant (p=0.001). MCV and MCH were also found to be higher among controls as compared to cases and this was found to be statistically significant (p = 0.00; p=0.00 respectively) (Table 1). WBC's were found to be higher among cases as compared to controls and this was found to be statistically significant (p=0.044). Neutrophils were found to be higher among cases as compared to controls and this was found to be statistically significant (p=0.00). Lymphocytes were found to be higher among controls as compared to cases and this was found to be statistically significant (p=0.00). Similarly immature granulocytes were found to be higher among cases as compared to controls and this was found to be statistically significant (p=0.00). Platelets were found to be higher among controls as compared to cases and this was found to be statistically significant (p=0.004) (Table 1).

On one way ANOVA, a statistically significant difference in red cell parameters like hemoglobin [F (2,116) = 3.17], p = 0.046., hematocrit [F (2,116) = 3.387], p = 0.037 was found between the three trimester(s). Similarly, a statistically significant difference in white blood cell indices like WBC [F (2,116) = 5.1], p = 0.007, neutrophils [F (2,116) = 11.72], p = 0.000, lymphocytes [F (2,116) = 12.39], p = 0.000 and immature granulocytes [F (2,116) = 8.18], p = 0.00, NRBC [F (2,116) = 3.2], p = 0.042 was found between the three trimester(s) as shown in Table 2. Tukey's post hoc test was applied to determine the difference between the three trimester. WBC's were found to be significantly higher among subjects in third trimester as compared to those in first trimester (p=0.006). Subjects in second trimester were found to have a higher hemoglobin as compared to those in third trimester and this was found to be statistically significant (p=0.00). Hematocrit was higher among subjects in first trimester as compared to those in third trimester and this was found to be statistically significant (p=0.025) (Table 3). Assumption of equal variances was violated by some independent variables like neutrophils, lymphocytes, immature granulocytes and nucleated RBC's as shown by Levene's test (p = 0.004, p= 0.003, p=0.005, p=0.000 respectively), therefore, Games Howell post hoc test was used to determine differences between the groups in these set of variables. Neutrophils were found to be higher among subjects in second and third trimester as compared to first trimester and this was found to be statistically significant (p= 0.022, p = 0.00 respectively). Lymphocytes were found to be higher among first trimester as compared to second and third trimester and this was found to be statistically significant (p= 0.035, p=0.00 respectively). Immature granulocytes were significantly higher among second (p= 0.041) and third trimester (p=0.000) as compared to first trimester (Table 3).

Discussion

Hematological changes that occur during pregnancy are physiological. Changes in pregnancy are brought about by hormones namely estrogen and progesterone secreted by the placenta.[7] This stimulates renin secretion which activates the renin angiotensin system along with mild

Table 1: Comparison of Hematological Profile Among Pregnant and Non-Pregnant Women

Hematological profile	Socio-economic status	Mean ± S.D.	T statistic	Confidence interval		p value
				Lower limit	Upper limit	
Red cell parameters						
RBC	Case	4.22 ± 1.04	1.125	-0.095	0.349	0.262
	Control	4.09 ± 0.65				
Hemoglobin	Case	10.9 ±1.66	-2.165	-0.9871	-0.1389	0.009
	Control	11.55 ± 1.65				
Hematocrit	Case	34.68 ± 4.25	-3.224	-3.19	-0.7713	0.001
	Control	36.66 ± 5.19				
MCV	Case	84.33 ± 8.67	-3.816	-7.9595	-2.5397	0.00
	Control	89.58 ±12.2				
MCH	Case	26.7 ± 3.5	-3.692	-2.76	-0.8416	0.00
	Control	28.5 ± 3.97				
MCHC	Case	31.5 ± 1.6	0.082	-0.504	0.548	0.935
	Control	31.5 ± 2.4				
RDW-SD	Case	47.06 ± 7.8	-3.566	-6.57	-1.89	0.00
	Control	15.43 ± 2.5				
RDW-CV	Case	15.62 ± 3.05	0.529	-0.52	0.90	0.597
	Control	15.43 ± 2.5				
White cell parameter						
WBC	Case	10.32 ± 3.01	2.021	0.021	1.67	0.044
	Control	9.48 ± 3.44				
Neutrophil	Case	69.35 ± 8.5	4.074	2.76	7.9	0.00
	Control	64. ± 11.4				
Lymphocyte	Case	21.13 ± 7.3	-3.927	-6.42	-2.13	0.00
	Control	25.4 ± 9.33				
Monocyte	Case	7.3 ± 5.77	-0.958	-2.52	-.871	0.39
	Control	8.16 ± 7.4				
Eosinophil	Case	2.5 ± 2.7	-1.463	-1.29	0.1917	0.145
	Control	3.11 ± 3.03				
Basophil	Case	0.266 ±0.59	0.437	-0.0885	0.139	0.663
	Control	0.240 ± 0.195				
Immature granulcyte	Case	0.802 ± 0.811	5.181	0.2739	0.6101	0.000
	Control	0.36 ± 0.45				
NRBC	Case	0.093 ± 0.326	2.53	0.0167	0.1362	0.013
	Control	0.017 ± 0.045				
Platelet count						
Platelet count	Case	2.3 ± 0.74	-2.895	-0.561	-0.106	0.004
	Control	2.6 ± 1.01				

Table 2: Comparison of Hematological Parameters Between The Trimester(S)

Hematological parameters	Trimester	Mean ± S.D.	F statistic	P value
Red cell parameters				
RBC	First	4.49 ± 1.51	2.5	0.084
	Second	4.08 ± 0.58		
	Third	4 ± 0.44		
Hemoglobin	First	11.45 ± 1.5	3.17	0.046
	Second	10.73 ± 1.78		
	Third	10.63 ± 1.6		
Hematocrit	First	35.9 ± 4	3.387	0.037
	Second	33.78 ± 4.4		
	Third	34 ± 4.1		
MCV	First	85 ± 9.67	0.430	0.652
	Second	83.2 ± 8.4		
	Third	84.57 ± 7.6		
MCH	First	27.14 ± 3.9	0.583	0.56
	Second	26.43 ± 3.5		
	Third	26.4 ± 3.11		
MCHC	First	31.8 ± 1.55	1.67	0.19
	Second	31.65 ± 1.69		
	Third	31.19 ± 1.54		
RDW-SD	First	47.54 ± 6.4	0.196	0.822
	Second	46.46 ± 6.6		
	Third	47 ± 10.46		
RDW-CV	First	15.37 ± 3.2	0.257	0.774
	Second	15.18 ± 2.24		
	Third	15.75 ± 3.6		
White cell parameters				
WBC	First	9.32 ± 2.95	5.1	0.007
	Second	10.59 ± 2.99		
	Third	11.36 ± 2.77		
NEUT	First	65.2 ± 8.7	11.72	0.000
	Second	70.5 ± 9		
	Third	73.54 ± 4.7		
LYMPH	First	24.66 ± 7.55	12.396	0.00
	Second	20.445 ± 7.6		
	Third	17.23 ± 4		
MONO	First	8.4 ± 9	1.688	0.189
	Second	6.13 ± 1.05		
	Third	7.22 ± 1.6		
EO	First	2.8 ± 2.8	2	0.139
	Second	2.9 ± 3.3		
	Third	1.7 ± 1.89		

Hematological parameters	Trimester	Mean ± S.D.	F statistic	P value
BASO	First	0.22 ± 0.13	1	0.357
	Second	0.379 ± 1		
	Third	0.191 ± 0.11		
IG	First	0.45 ± 0.37	8.18	0.00
	Second	0.93 ± 1.13		
	Third	1.11 ± 0.64		
NRBC	First	0.037 ± 0.06	3.2	0.042
	Second	0.055 ± 0.122		
	Third	0.209 ± 0.57		
Platelet count				
Platelet count	First	2.41 ± 0.77	1.05	0.351
	Second	2.43 ± 0.73		
	Third	2.2 ± 0.7		

Table 3: Group-Wise Comparison of Hematological Parameters within The Three Trimester(S).

Hematological parameter	Trimester	Trimester	Mean difference	p value
Red cell parameter				
RBC	First	Second	0.41	0.167
	First	Third	0.45	0.119
	Second	Third	0.04	0.978
Hemoglobin	First	Second	0.72	0.112
	First	Third	0.82	0.068
	Second	Third	0.963	0.000
Hematocrit	First	Second	2.13	0.054
	First	Third	1.91	0.025
	Second	Third	-0.219	0.97
MCV	First	Second	1.73	0.63
	First	Third	0.44	0.972
	Second	Third	-1.29	0.80
MCH	First	Second	0.71	0.634
	First	Third	0.73	0.627
	Second	Third	0.025	0.999
MCHC	First	Second	0.179	0.866
	First	Third	0.645	0.174
	Second	Third	0.4665	0.429
RDW-SD	First	Second	1.08	0.806
	First	Third	0.45	0.965
	Second	Third	-0.62	0.938
RDW-CV	First	Second	-0.44	0.79
	First	Third	-0.37	0847
	Second	Third	0.06	0.99

Hematological parameter	Trimester	Trimester	Mean difference	p value
White cell parameter				
WBC	First	Second	-1.27	0.12
	First	Third	-2	0.006
	Second	Third	-0.77	0.498
Neutrophil	First	Second	-5.30	0.022
	First	Third	-8.33	0.000
	Second	Third	-3.0	0.174
Lymphocyte	First	Second	4.22	0.035
	First	Third	7.4	0.000
	Second	Third	3.2	0.067
Monocyte	First	Second	2.3	0.164
	First	Third	1.21	0.615
	Second	Third	-1.09	0.696
Eosinophil	First	Second	-0.11	0.979
	First	Third	1.05	0.209
	Second	Third	1.17	0.170
Basophil	First	Second	-0.15	0.486
	First	Third	0.03	0.959
	Second	Third	0.187	0.377
Immature granulocyte	First	Second	-0.48	0.041
	First	Third	-0.65	0.00
	Second	Third	-0.1746	0.694
NRBC	First	Second	-0.018	0.68
	First	Third	-0.17	0.197
	Second	Third	-0.153	0.28
Platelet count				
Platelet count	First	Second	-0.021	0.99
	First	Third	0.20	0.432
	Second	Third	0.227	0.392

decrease in atrial natriuretic peptide causing sodium and water retention. There is increase the blood volume during pregnancy upto 1.5 litres mainly to meet the increased demands during pregnancy as vascular channels are formed for the fetus and to compensate for the blood loss during delivery.[8] By 6 to 8 weeks of gestation there is 10 to 15% rise in plasma volume.[9,10] Maternal erythropoietin production which rises due to renin secretion causes increase in red cell mass which is less compared to the increased plasma volume. This leads to reduced haemoglobin and dilutional anemia. The plasma volume increases during the course of pregnancy reaching its peak in the second trimester and hence the haemoglobin and the PCV drops in this trimester. By the third trimester the reduction in blood volume is less and reduction of haemoglobin is less with mild increase in the PCV. The present study is also consistent with this finding as the Hb level and PCV drops in the second trimester and then stabilises by third trimesrter. This finding is consistent with study from other researchers[5,11,12] and other internatonal studies. According to the standard laid down by WHO, anemia in pregnancy is present when the haemoglobin concentration in the peripheral blood is 11 gm/100ml or less.[13,14] Anaemia contributes to intrauterine growth restriction, preterm labour, abortions and it is also a primary cause of low immunity of both the mother and the baby, which makes them prone for several life

threatening infections.[15] In the present study the red cell indices MCH and MCHC shows a steady decline by third trimester but the MCV is showing a decline in the second trimester but again rising back in the third trimester. The MCH and MCV are statistically significant which matches with the mentioned previous studies. The decrease in MCV during second trimester can be attributed to the reduction in hemoglobin which is more pronounced in the second trimester which would have resulted in microcytosis. By the third trimester the RBC production is increased to meet the increased demand and more immature RBCs are released into the circulation resulting in macrocytosis and increased MCV. This finding is not in concordance with other previous studies.

Our study shows increase in total leucocyte count and neutrophil count in the course of pregnancy. Both these parameters are statistically significant when compared with control group. However no definite trend was noted for eosinophils, monocytes and basophils in our study and also all the three parameters were not statiscally significant. The lymphocyte count during pregnancy declined in our study and is statistically significant. This is in concordance with previous studies[16,17] although study in Lagos, Nigeria[7] shows increase in the lymphocyte count. The stresss during pregnancy results in increase in WBC count reaching maximum during third trimester.Neutrophils are major leukocytes in the differential count as this is due to reduced apoptosis of neutrophils in pregnancy[18] and also there is reduced chemotactic and phagocytic activity of neutrophils[19] due to the inhibitory substances present in the plasma of the of the pregnant women. Toxic granules in the neutrophils also increased. There is absolute monocytosis in the first trimester in the present study. Monocytes induce decidual cells to secrete PGE2 to prevent fetal allograft rejection.[20] Due to different geographical locations and physiological conditions the changes in different WBC cell types causing leucocytosis cannot be clearly defined[7].

The present study shows reduction in the platelet count with the progress of pregnancy reaching a minimum in the third trimester. This correlates with other similar previous Indian studies[5,11,12].This reduction is known as gestational thrombocytopenia. This is due to hemodilution, accelerated platelet clearance and platelet activation[21]. Platelet count is lower when compared with control but not significant. As in the present study most pregnant females have normal platelet count. If the platelet count in the beginning of pregnancy is towards the lower side of normal range then only it will fall below normal. This is due to two phenomenon that is increased blood volume and damage to the platelets as it flows through the rough and scarred surface of the placenta[22]. Most of the thrombocytopenia is mild. Lower limit of platelet count in pregnancy is 1.15 lakh/mm^3. [23]

Also the present study shows increase in the nucleated red blood cells and immature granulocytes with the progress of pregnancy both reaching peak in the third trimester and both these parameters are statistically significant. The immature granulocytes correlates with leucocytosis and neutrophilia which is also maximum in the third trimester. Immature granulocytes may be found in the peripheral blood of the pregnant women and is not pathological.[24]

Conclusion

Hemoglobin was significantly higher among second trimester and haematocrit was significantly higher in first trimesrer as compared to third trimester in both the cases. WBC was significantly higher among third trimester as compared to first. Neutrophils and immature granulocytes were found to be significant higher among second and third trimester as compared to first trimester. Lymphocytes were significantly higher among first trimester as compared to second and third. The findings of the study shall be a value addition in comparative analysis between pregnant and non pregnant females.

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