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Assessment of Coagulation and Haematological Parameters among Pregnant Women in Port Harcourt

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Pregnancy is the fertilization and development of an embryo or fetus in a woman's uterus. It is a critical stage of development during which maternal nutrition can strongly influence obstetric and neonatal outcomes. The aim of this study was to determine the effect of pregnancy on some coagulation and haematological parameters of pregnant women residing in Port Harcourt, Nigeria.
Method: This case-control study investigated 80 pregnant subjects and 20 non-pregnant controls. Haematological parameters were determined using a fully automated The SysmexXP-300, while the coagulation parameters (PT and INR) were determined with the automated method.
Results: The mean PT (s), HB (g/dl), PCV (%), PLT (x10^9/L), RBC (mcL), LYMPH (%), BASO (%) and EOSIN (%) counts were significantly lower among the pregnant subjects (5.02±5.82, 11.00±1.13 g/dl and 33.81±3.89%, 189.6±52.93 × 10^9/L, 3.95±0.50, 43.93±10.10 %, 0.9385±1.08 % and 1.12±1.32 %) compared to the non-pregnant controls (1.68±2.37, 12.01±1.29 g/dl, 37.31±3.39 %, 235.6±72.37 × 10^9/L, 4.45±0.35, 43.24±9.06, 2.11±0.94 and 2.15±1.47) respectively. There were no significant differences in the INR, MONO (%), MPV (fl), MCV (L/C), and MCH (g/c) between the pregnant subjects (0.92±0.11, 5.41±2.59 %, 11.67±4.848, 84.26±3.77 and 28.06±3.54) and non-

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pregnant controls (0.88±0.11, 5.58±2.65, 11.14±5.45, 82.52±10.45 and 26.96±1.85). The NEUT (%), PDW (%) and WBC (x10^9/L) were significantly higher among the pregnant subjects (44.90±11.24 %, 13.26±2.56 % and 8.35±2.982 x10^9/L) compared to the non-pregnant controls (46.63±9.96 %, 10.78±1.80 % and 4.71±0.81 x10^9/L).

Conclusion: This study has shown that pregnancy has a significant effect on some haematological and coagulation parameters of pregnant women in Port Harcourt. The result of this research work indicates the need to routinely monitor the complete blood count, thrombocytopenia and hyper-coagulative activity among pregnant women of African descendant.

Keywords: Coagulation; Haematological; pregnant; Port Harcourt.

1. INTRODUCTION

Significant changes occur in the haematological and coagulation system during pregnancy, dellivery, and puerperium in the plasma levels [1]. Therefore, Pregnancy which is a physiological phenomenon needs careful and early antenatal care to have a successful fetomaternal outcome [2]. It is a situation that creates deep physiological differences that happen to be more important as pregnancy develops [3].

Normal pregnancy is associated with some haemostatic changes; with features of increase in several clotting proteins including fibrinogen, decreasing in the concentration of natural anticoagulants, and less fibrinolytic activity [4,5].

Coagulation is the process by which blood forms clot. It is an important part of hemostasis that begins almost immediately after an injury to the blood vessels, which causes damage to the endothelial lining the vessel [6]. Prothrombin (coagulation factor II) is cleaved to form thrombin in the first step of the coagulation cascade, which ultimately results in the stemming of blood loss [7]. Thrombin, an activated prothrombin, is an enzyme that presides over the conversion of fibrinogen to fibrin [8].

Platelets play an important role in the body's hemostatic mechanism [1-12]. They initiate hemostasis by aggregating at the site of injury and plug endothelial defects that usually are a consequence of injuries sustained, in order to prevent further blood loss while other pathways of the coagulation system are being activated [13]. Some researchers have reported a decrease in platelet count in pregnancy compared to non-pregnant values [14,15].

Pregnancy is a risk factor for anemia and venous thrombosis. The incidence of venous thromboembolism is approximately 0.76 to 1.72 per 1,000 pregnancies, which is about 4–50 times higher than that in non-pregnant women, especially in the late-pregnancy and puerperium periods [16]. These are important causes of maternal morbidity and mortality. In response to this problem, this research proposes to investigate and analyze the effect of pregnancy on some coagulation parameters (PT and INR) and haematological parameters in order to reduce the risk of development of excessive loss of blood during delivery and improve the antenatal care given to pregnant women.

2. MATERIALS AND METHODS

2.1 Study Design

The study is a hospital based cross-sectional study among pregnant women and women who are apparently healthy and not. The subjects were selected using a well-structured questionnaire.

2.2 Study Area

This study was carried out at Ozuoba Model Primary Health Centre in Obio Akpor Local Government of Port Harcourt Metropolis in Rivers State

2.3 Study Population

A total of 100 subjects (apparently healthy adults) were recruited for this study which comprised of 80 adult pregnant women visiting antenatal clinic in Ozuoba Primary Health Care Center, Port-Harcourt and 20 age-matched, non-pregnant women residing in Port Harcourt metropolis that served as a control group. All subjects were apparently healthy and between the ages of 18 and 50 years and resident within Port Harcourt metropolis.

3. ELIGIBILITY OF SUBJECTS

3.1 Inclusion Criteria for Subjects

All pregnant women (subjects) were included according to these criteria: age ≥18 and ≤50 years, must be at least 1 month pregnant, must be without any history of bleeding disorders or oral anticoagulants, and willingness to give written informed consent after discussion of study procedures.

3.2 Exclusion Criteria for Subjects

Exclusion criteria included: age <18 and >50 years, menopausal and menstruating women, pregnancy-related problems, history of disseminated intravascular coagulation (DIC), functional abnormality of platelets and deficiency of coagulation proteins, anticoagulant therapy and refusal to give consent.

3.3 Inclusion Criteria for Control

Individuals recruited for control were included according to these criteria: age ≥18 and ≤50 years, must be apparently healthy, non-menopausal and non-menstruating.

3.4 Exclusion Criteria for Control

The following individuals were excluded as control for the study; age <18 and >50 years, subjects with bleeding disorders, underlying coagulation disorders, individuals on anticoagulants therapy and those that refused to give consent were excluded.

3.5 Sample Collection

6mls of venous blood was collected from each participant into an Ethylene Diamine Tetraacetic Acid (EDTA) bottle and sodium citrate bottle in equal volume of 3mls for each specimen. which was then used for the determination of full blood count and prothrombin time.

3.6 Method of the Test

Full Blood Count (FBC): Measurement of haemoglobin, red blood, cells, white blood cells and platelets count were done by automation using sysmex *x*p 300 Automated CBC Haematology Analyzer made by Beckman Coulter in Europe GnbH. The Prothrombin time was done by manual method.

3.7 Data Analysis

The data were presented in (Tables 1 and 2) and were presented as mean ± standard deviation and added using statistical packages for social sciences (SPSS, Version 20.0) and level of significance set at as p≤ 0.05. Rivers state hospital management board.

4. RESULTS

Table 1 shows the demographic distribution of the study population which includes:

The state of origin of participants used showed that Rivers, Akwa Ibom, Abia, Kogi, Ebonyi, Edo, Imo, Anambra, Bayelsa, Enugu and Delta had a frequency distribution of 0.48, 0.08, 0.08, 0.01, 0.04, 0.10, 0.03, 0.05, 0.05 and 0.04 respectively. This represents the percentage of 48%, 8%, 8%, 1%, 4%, 4%, 10%, 3%, 5%, 5% and 4% respectively.

Age groups of the population ranged from 18-28, 29-39 and 40-50 with the frequency distribution of the 0.35, 0.62 and 0.03 and percentage of 35%, 62% and 3% respectively.

The educational status of the study population showed that SSCE, tertiary and post graduate had frequency distribution of 0.51, 0.45 and 0.04 and percentage of 51%, 45% and 4% respectively.

The parity of the study population ranged from 0-1, 2-3, and 4-5 with the frequency distribution of 0.62, 0.32 and 0.06 respectively and the percentage of 62%, 32% and 6% respectively.

The occupation of participants in this study included business, teaching and student with the frequency distribution of 0.75, 0.13 and 0.12 and percentage of 75%, 13% and 12% respectively.

Table 2. shows Comparison of haematological parameters and prothrombin time of the study group, it was seen that PT (s), PDW (%), P-LCR (%), PCT (%), WBC ($x10^9$/L), RBC (mcL), HB (g/dl), MCHC (g/dl), PLT ($x10^9$/L), NEUT (%), LYMPH (%), EOSIN (%) and BASO (%), showed a statistical significant difference with a p-value of 0.0137, 0.0002, 0.0001, 0.0097, <0.0001, <0.0001, 0.0011, 0.0004, 0.0016, 0.0018, <0.0001, <0.0001, 0.0036 and <0.0001 respectively at p<0.05.

Further comparison of the test and the control subjects showed no statistical significant difference at p>0.05 for INR, MCV (l/c), MCH (g/c), RDW-SD, RDW-CV, MPV (fl) and MONO (%).

5. DISCUSSION

This research work is a cross sectional study carried out among pregnant women in Port Harcourt between the month of January and March 2021. It was carried out to investigate the haematological parameters and some coagulation parameters in pregnant women attending antenatal clinic in Ozuoba Primary Health Care Center, Port-Harcourt in comparison with non- pregnant women.

Assessing the demographic distribution of the study population, it was shown that the age groups of the population ranged from 18-28, 29-39, and 40-50 with the frequency distribution of the 0.35, 0.62 and 0.03 representing 35%, 62% and 3% respectively. This is in contrast to a study by Panti et al.[8], in their study they observed that younger women in the age group 21-25 years constituted a significant number of the subjects (36.7%) used in their study.

Comparing the haematological parameters and prothrombin time of the study group, it showed that PCV (%) and HB (g/dl) was significantly lower in pregnant women in comparison with non-pregnant women at a p-value of 0.0004 and 0.0011 respectively as seen in Table 2. This confirms the study by Van den broek et al. [17] that haemoglobin and packed cell volume fall during pregnancy because the expansion of plasma volume is greater than that of the red cell mass.

Table 1. Demographic characteristics of pregnant subjects

Subjects	No. of Participants	Frequency	Percentage
State of Origin			
Rivers	37	0.48	48
Akwa Ibom	6	0.08	8
Abia	6	0.08	8
Kogi	1	0.01	1
Ebonyi	3	0.04	4
Edo	3	0.04	4
Imo	8	0.10	10
Anambra	2	0.03	3
Bayelsa	4	0.05	5
Enugu	4	0.05	5
Delta	3	0.04	4
Age Groups			
18-28	27	0.35	35
29-39	48	0.62	62
40-50	2	0.03	3
Educational Status			
SSCE	39	0.51	51
TERTIARY	35	0.45	45
POSTGRAD	3	0.04	4
Parity			
0-1	47	0.62	62
2-3	25	0.32	32
4-5	5	0.06	6
Occupation			
Business	58	0.75	75
Teaching	10	0.13	13
Students	9	0.12	12

Table 2. Comparative analysis of haematological parameters and prothrombin time of pregnant subjects against non- pregnant subjects

Parameter	Pregnant subject	Non-pregnant subjects	p-value	t-value	Remark
PT(s)	5.02±5.82	1.68±2.37	0.0137	2.510	S
INR	0.92±0.11	0.88±0.11	0.1195	1.571	NS
WBC(x10^9/L)	8.35±2.982	4.71±0.81	<0.0001	5.247	S
RBC(x10^9L)	3.95±0.50	4.45±0.35	<0.0001	4.235	S
HB(g/dl)	11.00±1.13	12.01±1.29	0.0011	3.374	S
PCV(%)	33.81±3.89	37.31±3.39	0.0004	3.672	S
MCH(pg)	84.75±6.38	82.52±10.45	0.2276	1.214	NS
MCV(fL)	27.94±2.49	26.96±1.85	0.1059	1.634	NS
MCHC(g/dl)	142.7±150.7	32.14±0.80	0.0016	3.269	S
PLT(x10^9L)	189.6±52.93	235.6±72.37	0.0018	3.214	S
RDW-SD(fL)	43.19±5.09	41.51±3.64	0.1722	1.377	NS
RDW-CV(%)	13.78±0.93	13.36±1.09	0.093	1.696	NS
PDW(fL)	13.26±2.56	10.78±1.80	0.0002	3.847	S
MPV(fL)	10.54±0.91	11.14±5.45	0.3823	0.878	NS
P-LCR	29.60±7.17	21.98±8.29	0.0001	4.036	S
PCT(ml/L)	0.87±0.91	0.3150±0.37	0.0097	2.649	S
NEUT(x10^9L)	64.52±9.90	46.63±9.96	<0.0001	7.104	S
LYM(x10^9L)	27.68±8.85	43.24±9.06	<0.0001	6.982	S
MONO(x10^9L)	5.35±3.55	5.58±2.65	0.7950	0.260	NS
EOSINO(x10^9L)	1.12±1.32	2.15±1.47	0.0036	2.996	S
BASO(x10^9L)	0.71±0.86	2.11±0.94	<0.0001	6.216	S

Keys: S=Significant, NS= Not Significant

The WBC (x10^9/L) count was significantly higher in the pregnant women than in the female controls ($p<0.05$). The variations observed were all in line with the reports of Akinsegun et al. [18]; Ichipi-Ifukor et al. [9]; Elemchukwu et al. [19]; Okpokam et al. [20]; which stated that pregnancy lead to increase in white blood cell count due to physiological changes such as microtears, infection and even the needs of the developing baby, placenta and the uterus. In this study, the NEUT (%) was significantly higher than that of the female controls ($p<0.05$). This confirms the finding by Oke and Ugwu [21] and Luppi et al. [5] that neutrophils reach significance at 13-28 weeks of pregnancy. On the other hand, the LYMPH (%) in the control subjects were significantly higher than that of the pregnant women ($p<0.05$). These confirm the findings by Awodu et al. [22] that neutrophil counts increase during pregnancy while lymphocyte counts decrease.

The platelet counts in the female controls were significantly higher than that of the pregnant women. This confirms the findings by Karim and Sacher [10] and Berkowitz [23] that platelets are slightly lower during pregnancy due to accelerated destruction leading to younger and larger platelets.

It was also seen that PT (s), PDW (%), P-LCR (%) and PCT (%) showed a statistical significant difference at $p<0.05$. The result agreed with Durotoye et al. [24] six years ago that the hormones estrogen and progesterone which are necessary for the maintenance of pregnancy increase several folds and these especially estrogen stimulates hepatocytes (liver cells) thereby increasing the production of virtually all the coagulation factors thus, shortening the PT(s) in pregnant women. This study, however, was in contrast with Amah-Tariah et al. [25] who did not find any significant difference in levels of PDW and PCT.

Further comparison of the test and the control subjects showed no statistical significant difference at $P>0.05$ for INR and MPV (fl). This is in agreement with a study by Mercy et al. [13], who did not find a significant difference in MPV.

Comparing the prothrombin time and platelet indices of the study group according to parity, it was seen that PT (s), PDW (%), P-LCR (%), PCT (%), INR and MPV (fl) showed no statistical significant difference at $P>0.05$. This in agreement to a report by Abdullah [26] who reported that pregnancy have no effect on prothrombin time and platelet indices when 500

pregnant women in Kano were assessed based on parity.

The findings show that PDW is significantly increased during pregnancy. These changes might be related to the blood volume expansion and hemodilution that occurs during pregnancy. An increase in PDW has also been associated with an increase in platelet activation. This increase in PDW in pregnancy might contribute slightly to the hypercoagulability associated with pregnancy.

6. CONCLUSION

The findings have brought to fore that some apparently abnormal haematological values are pregnancy dependent physiologic changes without constituting a pathological process.

White blood cells and neutrophils were progressively increased whereas lymphocyte count, RBC count, hemoglobin and hematocrit were decreased in pregnant women compared to non-pregnant women as pregnancy advanced. So it is essential to monitor and manage these parameters during pregnancy.

It can be concluded that platelet count (and indices) are affected by pregnancy, and this is helpful in diagnosis of pre-eclampsia, ectopic pregnancy and Haemolysis elevated liver enzyme low platelet count (HELLP syndrome). There is thus a need to redefine thrombocytopenia in pregnancy in order to minimize the risk of unnecessary interventions or denial of necessary treatment.

The study also shows decreased Prothrombin time during normal pregnancy when compared with control groups of non-pregnancies, indicating hyper coagulation activity during pregnancy as a complementary mechanism in protecting the mothers at delivery.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical clearance was sought from and got from University of Port Harcourt Teaching Hospital Ethics Committee, Rivers State on 15th March, 2021. (UPTH/ADM/90/S.II/VOL.XI/504.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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