African Journal of Laboratory Haematology and Transfusion Science

Vol 3, Issue 4, Page 289 - 296 | December 2024 | www.ajlhtsonline.org
ARTICLE DOI: doi.org/10.59708/ajlhts.v3i4.2438
DOI URL: 10.59708/ajlhts.v3i4.2438

ORIGINAL ARTICLE

Assessment of Some Haematological and Systemic Inflammatory Markers among Pregnant Women with Hypertension at the University of Port Harcourt Teaching Hospital, Nigeria

Beauty Eruchi Echonwere-Uwikor, Serekara Gideon Christian, Peace Sylvanus Awo

Department of Haematology and Blood Transfusion Science, Faculty of Medical Laboratory Science, Rivers State University, Port Harcourt

Corresponding Author: Beauty Eruchi Echonwere-Uwikor, beautyechonwere@gmail.com, 08032767471

Received: 09-11-2024
Accepted: 19-11-2024
Published: 30-12-2024

Abstract

Introduction: Hypertension in pregnancy is one of the most common and potentially life-threatening complications of pregnancy. Pregnancy is known to be associated with various physiological changes ranging from increased plasma volume and red blood cell mass, leucocytosis, and adaptive immunological modifications to the relative hypercoagulable state of pregnancy. This syndrome has been recognized for centuries but aetiology remains uncertain, limiting effective intervention. This study aimed to assess some haematological and systemic inflammatory markers among hypertensive pregnant women attending antenatal care in selected health centres in Port Harcourt, Rivers State. Method: A cross-sectional study was employed for the study, which comprised 150 pregnant women, 75 normotensive pregnant women as control, and 75 hypertensive pregnant women, all between the ages of 18 and 43 years. Socio-demographic data was obtained from pregnant women using a well-structured questionnaire. Three (3) ml of venous blood was collected aseptically from the participants and dispensed into ethylene diamine tetraacetic acid (EDTA) anticoagulant bottle for full blood count (FBC) assessment using a Three (3) part Haematology autoanalyzer. The data generated from this study was analyzed using GraphPad Prism software version 6.00, USA. Data was presented as means and standard deviation, and the two means were compared using student t-test analysis.

Results: Among the 75 hypertensive women studied, 27 (36%) were classified as having stage 1 hypertension and 48 (64%) as stage 2 hypertension. The systolic and diastolic blood pressure status of women in the hypertensive group was significantly higher than those of women in the normotensive control group ($p<0.001$). Mean values of haematologic parameters measured for women in the hypertensive group was as follows: Hb (10.74±2.13), PCV (32.64±6.15), RBC (5.25±9.71), MCV (79.85±11.02), MCH (26.81±7.87),

MCHC (31.31±4.13), for WBC (8.29±16.81), Platelets (198.85±78.02), Neutrophils (57.85±14.52), Lymphocytes (35.28±14.52), Monocytes (3.76±1.87), and Eosinophils (2.15±1.99). Similar reading was noted for these parameters among the normotensive control, except for RBC, Neutrophils whose values decreased, and Eosinophils increased in hypertensive women. In the association of severity of hypertension with haematologic parameter assayed, it was observed that only monocyte level differed significantly between the 2 stages of hypertension. The mean monocyte level was significantly higher among stage 1 hypertensive patients than stage 2 hypertensive patients (4.04±2.25 and 3.60±1.59, respectively; t=0.949, p=0.038). MCH was shown to correlate significantly inversely with the severity of hypertension in the normotensive control group (R=-0.256, p=0.002).

Conclusion: During pregnancy, the occurrence of hypertension poses additional challenges to the haematopoietic system with resultant changes in haematological parameters, hence, simple, readily available clinical and laboratory parameters as indicators of the likely outcome of pregnancies complicated by hypertension are needed.

Keywords: Haematological, Systemic Inflammatory markers, Hypertensive Pregnant women, Port Harcourt

INTRODUCTION

Pregnancy is a period between fertilization of the ovum by a spermatozoon (conception) and birth, during which women carry their developing fetus in the uterus (1). These periods are characterized by several physiological alterations especially the components of the haematologic and haemostatic system; which have to be taken into account before assessing any significant deviation from the ordinarily accepted normal blood values (1). Hypertension is one of the serious complications seen in pregnancies (2). Hypertensive disorders of pregnancy are an umbrella term that includes preexisting and gestational hypertension, preeclampsia, and eclampsia, and these conditions complicate up to 7-10% of pregnancies and represent a significant cause of maternal and perinatal morbidity and mortality (3).

Pregnancy-induced hypertension is defined as newly diagnosed hypertension, which occurs in pregnancy after 20 weeks of gestation and disappears following delivery of the baby (4). The most current definition of hypertension in pregnancy was systolic blood pressure ⩾ 140 mmHg and/or diastolic blood pressure ⩾ 90 mmHg, measured at least in four hours. Most guidelines around the world are aligned in defining hypertension in pregnancy as blood pressure (BP) ≥140/90 mm Hg (3).

Pregnancy is characterized by several physiological alterations especially the components of the haematologic and haemostatic system (5). Changes associated with pregnancy may include alteration in haematological parameters such as expansion in maternal blood and plasma volume (6). Beginning early in the first trimester, there are surges of estrogen, progesterone, and relaxin (hormone that, like progesterone, mediates

nitric oxide release), leading to systemic vasodilation (7; 8). Concurrently, the renin-angiotensin-aldosterone system (RAAS) is augmented to prompt salt and water retention, expanding plasma volume (9). This, combined with an increased ventricular wall mass, increases stroke volume (10). Expanding plasma blood volume also results in physiologic anaemia (11).

Platelet counts in apparently healthy females are significantly higher than those of pregnant women, and thrombocytopenia is common in the third trimester due to haemodilution, increased platelet consumption, and increased platelet aggregation by increased levels of thromboxane A2 (5,12). Other red cell indices are not significantly affected, although there may be variations in shape and size than in the non-pregnant state (13). There is a slight increase in the mean corpuscular volume (MCV) of about 4femtoliters, independent of vitamin B12 or folate deficiency (13). There is an increase in white blood cell count in pregnancy due to physiological changes such as microtears, infection and the needs of the developing baby, placenta and the uterus (5).

MATERIALS AND METHODS

Study Design: A cross-sectional study was carried out to assess the haematological parameters among hypertensive pregnant women attending antenatal care at the University of Port Harcourt Teaching Hospital, Rivers State.

Study Area: This study was carried out on women attending the antenatal clinics at the obstetrics and gynecology department of the University of Port Harcourt Teaching Hospital, Rivers State, Nigeria.

Study Population

The study was conducted among hypertensive pregnant women attending antenatal care at the University of Port Harcourt Teaching Hospital. A total of 150 samples were collected for this study. Seventy-five (75) samples were from confirmed hypertensive pregnant women and 75 from apparently healthy normotensive pregnant women, all between the ages of 18-43 years.

ELIGIBILITY CRITERIA

Inclusion criteria

1. Pregnant women more than 28 weeks gestation of pregnancy with blood pressure >140/90mmhg.
2. Women between the ages 18 to 43 years.

Exclusion criteria

1. Non-pregnant women.
2. Pregnant women who are not hypertensive.
3. Women with previous history of hypertension and proteinuria before conception or before 20 weeks of gestation.
4. Pregnant women with history of systemic illnesses like diabetes mellitus, renal disease, and liver disease.

Informed Consent

Informed consent was obtained from participants before blood collection. Blood pressure was confirmed for each participant before blood collection, and the participants were made to understand the nature of the study and the fact that the participation is voluntary, with confidentiality of recovered data maintained at all times during and after the study. Socio-demographic data was obtained from pregnant women using a well-structured questionnaire. Ethical approval was obtained from the Ethical Committee of the University of Port Harcourt Teaching Hospital, Nigeria.

Blood collection

Three (3) ml of venous blood was collected aseptically from the participants and dispensed into ethylene diamine tetraacetic acid (EDTA) anticoagulant bottle for complete blood count (FBC) assessment.

Sample Analysis

Complete blood count measurement was done using the Zybio Z3 three (3) part differential haematology autoanalyzer (Inspiration Biotech, Moradabad, Uttar Pradesh, India).

Data Analysis

The data obtained was analyzed using GraphPad Prism software version 6.00, USA, and presented as means and standard deviation. Comparison between two means was done using student t-test analysis, while comparison between more than two was done using one-way analysis of variance (ANOVA).

Table 1: Demographics Characteristics of Respondents

	Hypertensive (n=75)		**Normotensive (n=75)**			
	Frequency	**Percent**	**Frequency**	**Percent**	**χ2**	**p-value**
Age group (years)						
Less than 30	34	45.3	39	52	0.667	0.414
30 and above	41	54.7	36	48		
					t	**p-value**
Mean age (SD) (years)	29.99 (5.78)		29.2 (5.93)		0.823	0.412
Parity						
Nil	14	18.7	16	21.3	5.233	0.264
One	25	33.3	26	34.7		
Two	25	33.3	22	29.3		
Three	7	9.3	11	14.7		
Four	4	5.3	0	0		
					t	**p-value**
Blood Pressure Status						
Mean SBP (SD)	153.83 (16.23)		123 (9.34)		14.259	**<0.001***
Mean DBP (SD)	100.85 (8.42)		78.04 (12.15)		13.364	**<0.001***

SD=Standard Deviation; *=Statistically Significant at p<0.05, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure

Table 2: Haematologic Parameters of Hypertensive and Normotensive Pregnant Women

	Hypertensive			**Normotensive**				
Parameter	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**	**t**	**p-value**
Hb	75	10.74	2.136	75	10.6	1.17	0.474	0.636
PCV	75	32.67	6.1516	75	32.827	3.8074	-0.185	0.853
RBC	75	5.25	9.717	75	12.67	16.067	-3.423	**0.001***

MCV	75	79.85	11.027	75	80.47	17.822	-0.257	0.798
MCH	75	26.81	7.879	75	27.05	2.995	-0.247	0.806
MCHC	75	31.31	4.1302	75	36.4	33.3305	-1.311	0.192
WBC	75	8.29	16.8177	75	6.819	2.3735	0.754	0.452
Platelets	75	198.85	78.022	75	188.4	73.206	0.846	0.399
Neut	75	57.85	14.425	75	62.53	13.625	-2.043	**0.043***
Lymp	75	35.28	14.522	74	32.2	12.007	1.409	0.161
Mono	68	3.76	1.87	74	3.42	2.735	0.872	0.385
Eos	65	2.15	1.994	67	1.54	1.02	2.246	**0.026***

SD=Standard Deviation; *=Statistically Significant at p<0.05

Table 3: Severity of Hypertension among Respondents

	Hypertensive (n=75)		**Normotensive (n=75)**			
Hypertension Status	**Frequency**	**Percent**	**Frequency**	**Percent**	**χ2**	**p-value**
Normal	0	0.0	22	29.3	97.449	**<0.001***
Prehypertension	0	0.0	37	49.3		
Stage 1 Hypertension	27	36.0	7	9.3		
Stage 2 Hypertension	48	64.0	9	12.0		

*=Statistically Significant at p<0.05

Table 4: Association of Severity of Hypertension with Haematologic Parameters

Parameter	**Stage 1 Hypertension (n=27)**		**Stage 2 Hypertension (n=48)**		**t**	**p-value**
	Mean	**SD**	**Mean**	**SD**		
Hb	10.47	2.04	10.89	2.19	-0.817	0.713
PCV	32.67	5.949	32.67	6.32	-0.006	0.823
RBC	4.01	0.90	5.95	12.12	-0.825	0.233
MCV	81.52	8.85	78.92	12.07	0.981	0.406
MCH	26.19	3.10	27.17	9.59	-0.515	0.377
MCHC	31.70	2.15	31.09	4.92	0.609	0.259
WBC	6.88	2.06	9.09	21.00	-0.544	0.264
Platelets	203.56	73.49	196.21	81.10	0.389	0.452
Neut	58.78	14.60	57.33	14.46	0.414	0.763
Lymp	35.04	13.80	35.42	15.05	-0.108	0.722

Mono	4.04	2.25	3.60	1.59	0.949	**0.038***
Eos	2.14	1.52	2.16	2.21	-0.05	0.977

SD=Standard Deviation; *Statistically Significant at p<0.05

DISCUSSION

Hypertension in Pregnancy is affected by variables beyond age, including genetics, pre-existing conditions, and lifestyle factors, which are not exclusive to specific age groups. As such, this study found no statistically significant differences in the age distribution of the study participants. Also, only women of reproductive age were included, thus reducing variability in age between the two groups, making it difficult for age alone to show significant differences in hypertensive and normotensive pregnant women. Studies by (14-16) also reported advanced maternal age to be a risk factor that is not predictive of its own. Instead, other risk factors, like obesity, diet, and family history, play substantial roles in significant differences in hypertension prevalence. The decreased RBC count could be attributed to preeclampsia, which leads to reduced RBC counts due to hemodilution. Studies by (17) reported that the decrease in RBC count is due to an increase in blood plasma volume more than RBC production and microangiopathic hemolysis from endothelial damage associated with hypertension. The variations in neutrophil and Eosinophil counts in hypertensive pregnancies compared to normotensive ones result from shifts in immune response and inflammation specific to hypertension in pregnancy. Another study by (18) reported a decrease in neutrophil counts due to their consumption in responding to inflammatory processes in the innate immune system, which are heightened in hypertensive pregnancies. Conversely, eosinophils, which play a role in inflammatory modulation and allergic responses, may increase in some hypertensive pregnant women, possibly due to shifts in immune signaling pathways that favor an up-regulation of specific white blood cells under stress or inflammatory stimuli associated with hypertension. Recent studies by (19,20), had reported similar findings on increased eosinophils in hypertensive pregnancies. This elevation might be an adaptive response aimed at controlling inflammatory levels, although individual immune profiles vary significantly, which can influence this haematologic change. The increased systolic and diastolic blood pressure status seen in the hypertensive pregnant group was a result of increased vascular resistance, inflammation, and placental factors. Specific physiological mechanisms activated by hypertensive disorders, such as preeclampsia and gestational hypertension, are marked by endothelial damage, which disrupts the function of normal blood vessels and raises systemic vascular resistance. (21), in their study, have it that vascular and endothelial factors, endothelial injury impairs the ability of blood vessels to dilate, leading to increased vascular resistance and blood pressure as the blood vessels become less flexible in response to the heightened circulatory demands of pregnancy. Also, (22), in their study, reported that hypertensive pregnant women often exhibit elevated inflammatory cytokines, which contribute to vascular stiffness and constriction and increased blood pressure as the body responds to abnormally inflammatory signals, which the immune response should have managed. A study by (23) also reported increased

systolic and diastolic blood pressure as a result of placenta hypoxia, which leads to the release of antiangiogenic factors such as soluble Flt-1, which disrupts blood vessel formation and increases blood pressure. The increased monocyte count could be the body's amplified inflammatory response to hypertension in pregnancy to mitigate and repair damage in hypertensive patients. Studies by (18,24) attributed a higher monocyte level to promoting inflammation, as they differentiate into macrophages and dendritic cells that intensify inflammatory response in hypertension. Furthermore, another study by [2], also suggested that monocytes play a specific role in the inflammatory cascade of moderate-to-severe hypertensive disorders.

CONCLUSION

During pregnancy, the occurrence of hypertension poses additional challenges to the haematopoietic system with resultant changes in haematological parameters. This study found decreased neutrophil and increased eosinophil values for hypertensive pregnant women when compared with normotensive pregnancies. The association of severity of hypertension with haematologic parameters only revealed an increase in monocyte value between hypertensive women categorized as stage 1 and stage 2 hypertension, and the reason for this was not clear. Only MCH showed a weak correlation between the severity of hypertension and haematologic parameters among pregnant women.

REFERENCES

1. Echonwere-Uwikor BE, Moore-Igwe BW, Chukuigwe-Igbere OE, Chukwu PH. Evaluation of Changes in Haemostatic Parameters in Pregnancy and Puerperium in Women attending Antenatal Clinic at Rivers State University Teaching Hospital, Nigeria. *International Journal of Blood Research and Disorders*, 2022; 9(82): 1-8.
2. Wu P, Green M, Myers J. Hypertensive disorders of pregnancy. *British Medical Journal*. 2023; 381: 071653.
3. American College of Obstetricians and Gynecologists' Committee on Practice Bulletin. ACOG Practice Bulletin No. 222: gestational hypertension and preeclampsia. *Obstetrician and Gynecology*. 2020; 135: 1492–1495.
4. Bhutani N, Jethani V, Jethani S, Ratwani K. Coagulation profile and platelet parameters in pregnancy induced hypertension cases and normotensive pregnancies: A cross-sectional study. *Annals of Medicine and Surgery*. 2002; 80: 104124.
5. Echonwere-uwikor BE, Uwikor FK, Chukuigwe-Igbere OE, Chukwu PH, Worlu GO. Assessment of Coagulation and Haematological Parameters among Pregnant Women in Port Harcourt. *International Blood Research & Reviews*. 2002; 13(1): 1-7.
6. De Haas S, Ghossein-Doha C, Van Kuijk SMJ, Van Drongelen J, Spaanderman MEA. (2017). Physiological adaptation of maternal plasma volume during pregnancy: a systematic review and meta-analysis. *Ultrasound in Obstetrics & Gynecology*. 2017; 49(2): 177-187.
7. Berkane N, Liere P, Oudinet JP, Hertig A, Lefevre G, Pluchino N, Chabbert-Buffet N. From pregnancy to preeclampsia: a key role for estrogens. *Endocrine Reviews*. 2017; 38(2): 123-144.
8. Kodogo V, Azibani F, Sliwa K. Role of pregnancy hormones and hormonal interaction on the maternal cardiovascular system: a literature review. *Clinical Research in Cardiology*. 2019; 108(8): 831-846.
9. Lumbers ER, Pringle KG. Roles of the circulating renin-angiotensin-aldosterone system in human pregnancy. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*.2014; 306(2): 91-101.
10. Ngene NC, Moodley J. Physiology of blood pres-

sure relevant to managing hypertension in pregnancy. *The Journal of Maternal-Fetal & Neonatal Medicine*, 2019; 32(8): 1368-1377.
11. Horowitz KM, Ingardia CJ, Borgida AF. Anemia in pregnancy. *Clinics in Laboratory Medicine*. 2013; 33(2): 281-291.
12. Chaithra H, Ramesh ST, Riyaz AA. Comparative study of coagulation profile and haematological parameters in pregnancy induced hypertension (PIH). *Tropical Journal of Pathology and Microbiology*.2021; 7(3): 150-155
13. Horowitz KM, Ingardia CJ, Borgida AF. Anemia in pregnancy. *Clinics in Laboratory Medicine*. 2013; 33(2): 281-291.
14. Magee LA, Brown MA, Hall DR, Gupte S, Hennessy A, Karumanchi SA, von Dadelszen P. The 2021 International Society for the Study of Hypertension in Pregnancy classification, diagnosis & management recommendations for international practice. *Pregnancy hypertension*. 2022; *27*: 148-169.
15. Nobles CJ, Mendola P. Mumfor S, Silver RM, Kim K. Andriessen VC, Schisterman EF. (2020). Preconception blood pressure and its change into early pregnancy: early risk factors for preeclampsia and gestational hypertension. *Hypertension*. 2020; 76(3): 922-929.
16. Lopian M, Kashani-Ligumsky L, Many A. A Balancing Act: Navigating Hypertensive Disorders of Pregnancy at Very Advanced Maternal Age, from Preconception to Postpartum. *Journal of Clinical Medicine*, 2023; 12(14): 4701.
17. Khan SS, Cameron NA, Lindley KJ. (2023). Pregnancy as early Cardiovascular Moment: *Peripatum Cardiovascular Health*. 2013; 132: 12.
18. Veena SR, Kuruvil SK. Significance of leukocyte and platelet counts in hypertensive disorders of pregnancy - A retrospective study in a tertiary care hospital. *Indian Journal of Obstetrics and Gynecology Research*. 2024; 11(3): 398-402.
19. Covali R, Socolov D, Socolov R, Pavaleanu I, Carauleanu A, Akad M, Adam AM. (2021). Complete blood count peculiarities in pregnant SARS-CoV-2-infected patients at term: a cohort study. *Diagnostics*. 2020; 12(1): 80.
20. Ali Z, Khaliq S. Hematological Markers: Emerging Diagnostic and Therapeutic Targets in Preeclampsia. *Front Clinical Drug Research-Hematology*. 2022; 5: 192.
21. Odukoya SA, Moodley J, Naicker T. Current Updates on Pre-eclampsia: Maternal and Foetal Cardiovascular Diseases Predilection, Science or Myth? Future cardiovascular disease risks in mother and child following pre-eclampsia. *Current Hypertension Reports*. 2021; *23*: 1-14.
22. Dimitriadis E, Rolnik DL, Zhou W. Pre-eclampsia. *Nature Review Disease Primers*. 2023; 9: 8.
23. Staff AC, Dechend R. Hypertensive Disorders of Pregnancy and Cardiovascular. *Manual of Cardiovascular Disease in Women*. 2022; 119.
24. True H, Blanton M, Sureshchandra S. Messaoud I. Monocytes and macrophages in pregnancy: The good, the bad, and the ugly. *Immunology Review*. 2022; 308(1): 77-92.

How to cite this article

Echonwere-Uwikor BE, Christian SG, Awo PS. Assessment of Some Haematological and Systemic Inflammatory Markers among Pregnant Women with Hypertension at the University of Port Harcourt Teaching Hospital, Nigeria. *Afr J Lab Haem Transf Sci* 2024;3(4): 289 - 296 DOI: https://doi.org/10.59708/ajlhts.v3i4.2438