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Original Research Article

HEMATOLOGICAL PARAMETERS OF PREECLAMPSIA AMONG PREGNANT WOMEN ATTENDING ANTE NATAL CLINIC AT A GOVERNMENT GENERAL HOSPITAL IN TELANGANA: A CROSS SECTIONAL COMPARATIVE STUDY

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Abstract

Background: Preeclampsia is a kind of pregnancy-related hypertension that affects approximately 10% of pregnancies in worldwide. Preeclampsia is a hypertension condition that has a significant influence on maternal and newborn health. Objective: This study sought to identify hematological preeclampsia markers in pregnant women. **Materials and Methods:** This comparative cross-sectional study was conducted in Government Medical College (GMC). This study was approved by the Ethical Committee of Government Medical College, Mahabubabad. The study was conducted from February 2024 to March 2025. A total of 150 pregnant women were included in the study (50 with preeclampsia and 100 without preeclampsia). Epi-info 7.2.6.0 was used to enter data, and SPSS version 22 was used for analysis. The descriptive statistics as mean with standard deviation (SD), median and interquartile ranges of all the parameters were calculated for cases and controls. Normality of data was checked with Kolmogorov-Smirnov test and the mean differences were tested with independent sample t-test. The value of $p < 0.05$ was considered significant. **Result:** A total of 150 pregnant women were studied. Blood cell count analysis of each study participant's result showed that the means of most of the hematological parameters were not statistically different except for relative lymphocyte count ($p = 0.026$), red blood cell distribution width (RDW-SD) ($p = 0.061$), and neutrophil-lymphocyte ratio (NLR) ($p = 0.041$), even though numerical differences were evident. **Conclusion:** RDW, NLR, and lymphocyte count can be potential candidates for the diagnosis and screening of preeclampsia, as these tests are easily available and cost-effective. They are performed routinely in the laboratory.

INTRODUCTION

Among all antenatal adverse conditions, preeclampsia is the most serious.[1] It is a significant cause of maternal and fetal morbidity and mortality. In the majority of cases, preeclampsia symptoms are mild to moderate. However, a significant proportion of patients experience severe adversity.[2-4] While motherhood is a wonderful and rewarding experience for many women, it is often fraught with sorrow, disease, and death. Approximately 15 % of pregnant women are likely to experience life-threatening complications during pregnancy, delivery, or the postpartum period. Hypertensive disorders of pregnancy (HDP) exacerbate these problems and sufferings.[5, 6] A pregnant woman is considered hypertensive if her blood pressure is greater than or equal to 140/90 mmHg on two consecutive measurements at least 4 h apart.[7] HDP is a general term for increased blood pressure during pregnancy. It includes pregnancy-induced hypertension (PIH) (hypertension without proteinuria), preeclampsia (hypertension with proteinuria), eclampsia (preeclampsia with convulsions), gestational hypertension, and chronic hypertension.[8] HDP is a global public health issue. It affects about 10 % of all pregnant women worldwide. Preeclampsia (PE) is a hypertension condition that has a significant

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influence on maternal and newborn health. It is a prominent cause of maternal and neonatal death and morbidity across the world. Preeclampsia is linked to problems with the placenta that begin early in pregnancy, leading to significant inflammation and increasing damage to blood vessel linings, but we still don't fully understand how this condition develops.[9] Research around the world showed that PE and eclampsia are linked to higher rates of death and health problems for mothers and babies, as well as more premature and smaller-than-normal births. Women with HDP are five times more likely to have perinatal death compared to those without HDP. Pulmonary embolism is believed to account for 40–60% of maternal mortality in underdeveloped countries. Moreover, in contrast to women in high-resource nations, women in low-resource countries face a heightened risk of developing PE.[10, 11]Many factors can increase risks for mothers, such as being older, never having given birth before, having a history of PE, having short or long gaps between pregnancies, using assisted reproductive technologies, having a family history of PE, being obese, being of South Asian descent, and having other health issues like high blood sugar during pregnancy, chronic high blood pressure, kidney disease, and autoimmune diseases.[7] The International Society for the Study of Hypertension in Pregnancy (ISSHP) suggests that pregnant women who develop high blood pressure for the first time should have lab tests done to check their hemoglobin, platelet count, serum creatinine, liver enzymes, and serum uric acid to see if there are any problems with their organs and to diagnose preeclampsia.[12] The prediction and diagnosis of PE mainly rely on the assessment of some risk factors and a few diagnostic methods (blood pressure and proteinuria). The identified risk factors, despite their high prevalence, do not accurately predict the onset of PE. And also, preventative therapies only moderately reduce a woman's risk of preeclampsia.[13]

Therefore, it is important to predict the risk of preeclampsia early in pregnancy using an effective, simple, and economical laboratory method to prevent complications and improve outcomes. Thus, the aim of this study was to identify hematological predictors of preeclampsia among pregnant women.

MATERIALS AND METHODS

Study Design

This comparative cross-sectional study was conducted in Government Medical College (GMC). This study was approved by the Ethical Committee of Government Medical College, Mahabubabad. The study was conducted from February 2024 to March 2025.

Study population and sample size

A formula of hypothesis testing for two population means was used to determine the initial sample size [8].

$$N=\frac{(r+1)(\frac{Za}{2}+Z1-\beta)^2\delta^2}{rd^2}$$

Where N = total sample size, r = sample allocation ratio (n_2/n_1; where n_1 is for cases group and n_2 for the comparator (control)group), α = margin of error, 1-β = power, δ and d are the pooled standard deviation and difference of means of two groups respectively.Where N = total sample size, r = sample allocation ratio (n2/n1; where n1 is for the cases group and n2 for the comparator (control) group), α = margin of error, 1-β = power, δ and 'd'are the pooled standard deviation and difference of means of two groups, respectively.To find the right sample size, researchers looked at the Platelet Large Cell Ratio (P-LCR) and standard deviations for PE and normal pregnancy from a study. Using a 0.05 chance of error, a 5% margin of error, and a 95% confidence level, the sample size needed is 128. Using 0.05 of β, a 5 % margin of error (α = 0.05), a 95 % confidence level, and the aforementioned means and standard deviations, the sample size becomes 150. By adding a 10 % attrition rate, the final sample size was 175. A 1:2 allocation ratio was utilized considering the availability of cases (PE group). Therefore, 50 pregnant women with preeclampsia and 100 normotensive pregnant women wereincluded using consecutive sampling techniques and systematic random sampling techniques respectively.

Inclusion Criteria

We will include pregnant women who attend GMC during the study period and are in their 11thweek or more.

Exclusion Criteria

Pregnant women who had a stillbirth, a history of pregnancy problems (like repeated miscarriages, early labor, or babies not growing properly) diabetes, heart, kidney, or liver issues, inflammation, active infections, smoking, or blood disorders were not included in the study.

Pregnant women with preeclampsia: A pregnant woman with blood pressure ≥140/90 mm Hg from two consecutive measurements 4h apart and proteinuria ≥300 mg/dL as early as the 20thgestational week of pregnancy accompanied by and edema and other major symptoms such as headache, blurred vision, and right upper quadrant pain, confirmed by an attending gynecologist.\

Study Procedure

The clinical data of pregnant women, including maternal age, gestational weeks, gravidity, parity, and blood pressure, were gathered using a semi-structured questionnaire by trained midwife nurses. Blood pressure was measured using a mercury sphygmomanometer by certified midwife nurses. The first reading was taken after the pregnant women had rested for 15 min, and the second reading was taken after 4 h.

Blood samples were collected from the study participants with anticoagulant-coated 4 ml EDTA-K3 Vacutainer tubes by trained laboratory technologists. We tagged each sample with the

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participant's codes and matched it with the questionnaires. Complete blood count was analyzed with a Sysmex KX21 automated hematology analyzer (Sysmex, Cobe, Japan). A single random urine sample was collected with a dry, leakproof container and tested for dipstick proteinuria analysis. All laboratory tests were performed as per the standard operating procedure and manufacturer's instructions.

We ensured the quality of collected data by adhering to the standard operating procedure. Every day, investigators checked the validity of the data collected from each questionnaire. A calibrated device for measuring blood pressure with a mercury sphygmomanometer was used. We used known control standards to verify the hematology auto-analyzer's quality. We conducted each laboratory analysis according to the manufacturer's instructions for using diagnostic instruments.

Limitation of the Study

This study tried to find the best clinically applicable diagnostic and screening hematological parameter whereas, due to cross-sectional nature of the study design, it couldn't analyze each pregnant women's hematological parameters and show whether there were changes through trimesters.

Statistical Analysis

Statistical analyses were done using Epi-info 7.2.6.0 and SPSS for Windows software (version 22; SPSS Inc., Chicago, IL, USA). The descriptivestatistics as mean with standard deviation (SD), median and interquartile ranges of all the parameters were calculated for cases andcontrols. Normality of data was checked with Kolmogorov-Smirnov test and the mean differences were tested with independent sample t-test. The value of $p < 0.05$ was considered significant.

RESULTS

Maternal and clinical characteristics of study participants

A total of 150 pregnant women (100 normotensive and 50preeclamptic) were recruited for this study. The mean age of normotensivepregnant women was 26.89 ± 4.86years while it was 27.98 ± 5.21years for preeclamptic patients. The numbers of gravidityamong normotensive and preeclamptic pregnant women were 2.45 ± 1.38 and 3.14 ± 1.87 pregnancies respectively. Weeks of gestation, years between previous and current pregnancy, mean arterial pressure were significantly variable (Table 1).

Table 1: Maternal and clinical characteristics of pregnant women at GMC

Characteristics	Non-preeclamptic (control) groups (N = 100)	Preeclamptic (case) groups (N = 50)	P- Value
	Mean ± SD	Mean ± SD	
Age (Years)	26.89 ± 4.86	27.98 ± 5.21	0.22
Gravidity	2.45 ± 1.38*	3.14 ± 1.87	0.023
Parity	1.47 ± 1.02*	2.46 ± 1.98	0.001
Weeks of gestation	24.92 ± 4.52	35.17 ± 3.32	<0.001
Years between previous and current pregnancy	1.82 ±1.12	2.88 ± 1.80	<0.001
Mean Arterial pressure	89.25 ± 5.92	118.92 ± 5.51	<0.001

**The values are proportion.*

Hematological characteristics of pregnant women

The complete blood cell count analysis of each study participant's result showed that the means of most of the hematological parameters were not statistically different except for relative lymphocyte count ($p = 0.026$), red blood cell distribution width (RDW-SD) ($p = 0.061$), and neutrophil-lymphocyte ratio (NLR) ($p = 0.041$), even though numerical differences were evident (Table 2). The hematological parameters evaluated showed statistically significant differences between the study groups (normotensive and preeclamptic pregnant women).

Table 2: Hematological characteristics of pregnant women at GMC

Characteristics	Non-preeclamptic (control) groups (N = 100)	Preeclamptic (case) groups (N = 50)	P- Value
	Mean ± SD 95 % Cl [Min; Max]	Mean ± SD 95 % Cl [Min; Max]	
Total White Blood Cell count ($x10^9$/L)	8.26 ± 2.56 [4.10;17.50]	9.30 ± 3.30 [4.60;18.00]	0.054
Relative Lymphocyte Count (%)	22.91 ± 9.24 [5.10;59.20]	19.70 ± 7.70 [6.70;41.10]	0.026
Relative Mixed cells count (%)	10.95 ± 3.75 [5.80;25.60]	11.20 ± 4.31 [5.10; 27.10]	0.728
Absolute Neutrophil ($x10^9$/L)	5.67 ± 2.45 [1.18;14.02]	6.60 ± 2.92 [1.83 15.10]	0.056
Absolute Lymphocyte ($x10^9$/L)	1.78 ± 1.51 [0.32;2.84]	1.72 ± 0.67 [0.61;4.65]	0.737
Absolute Mixed cells ($x10^9$/L)	0.87 ± 0.28 [0.24;1.66]	0.99 ± 0.40 [0.3;2.4]	0.061
Neutrophil-lymphocyte ratio (%)	3.50 ± 2.12	4.33 ± 2.40	0.041

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	[0.06;2.42]	[0.09;1.03]	
RBC ($x10^{12}$/L)	3.28 ± 1.59 [2.27;5.49]	3.50 ± 1.80 [1.74; 6.82]	0.79
Hemoglobin (g/dl)	9.61 ± 2.10 [5.0;17.30]	9.09 ± 2.44 [5.70;18.80]	0.201
Hematocrit (%)	28.80 ± 6.04 [21.0;52.60]	27.27 ± 7.83 [10.50;61.10]	0.229
MCH (pg)	25.41 ± 2.72 [16.80;34.10]	26.75 ± 3.44 [17.50;33.00]	0.019
MCHC (mg/dl)	31.27 ± 1.42 [25.90;34.40]	31.00 ± 1.81 [25.40;34.70]	0.359
MCV (fl)	94.19 ± 6.48 [68.90;107.10]	93.36 ± 9.38 [64.40;125.0]	0.576
RDW-SD (%)	16.21 ± 1.77 [12.10; 23.50]	17.04 ± 2.82 [12.50; 26.50]	0.061
Platelet count ($x10^{9}$/L)	202.20 ± 90.12 [52.00;580.00]	178.00 ± 61.81 [68.00; 387.00]	0.056
MPV (fl)	10.71 ± 1.50 [7.60;14.60]	10.97 ± 1.57 [7.80;13.60]	0.334
PDW (%)	14.12 ± 2.52 [8.30;22.30]	14.48 ± 2.50 [8.90;19.20]	0.409
PCT	0.21 ± 0.08 [0.06;0.54]	0.192 ± 0.06 [0.08;0.35]	0.125
PLR	127.24 ± 92.07 [27.57;718.22]	118.09 ± 61.58 [30.96;354.61]	0.472

Abbreviations= RBC: Red Blood cells, MCH, mean cell volume; MCHC, Mean corpuscular hemoglobin concentration; MCV, Mean corpuscular volume,RDW-SD; Red cell distribution width (Standard deviation), PDW: platelet distribution width, MPV: mean platelet volume, PCT: Plateletcrit, PLR: platelet-Lymphocyte ratio, CI: Confidence interval.

DISCUSSION

After the 20th week of gestation, blood pressure and proteinuria evaluations routinely lead to the diagnosis of preeclampsia. Although pathophysiological changes (e.g., inadequate placentation) exist from very early stages of the pregnancy, hypertension and andproteinuria usually become apparent in the second half of pregnancy and are present in 2%-8% of all pregnancies overall.[14] This phenomenon makes the current available methods for diagnosis, screening, and classification controversial. Therefore, this study aimed to explore the potential diagnostic and screening capabilities of hematological parameters using easily accessible resources.

The findings of this study indicated that the means of RDW (p = 0.061), NLR (p = 0.041), and relative lymphocyte count (p = 0.026) had differences between pregnant women with and without preeclampsia. Different studies had reported that platelet count and platelet indices like MPV, PDW, and plateletcrit were statistically different between PE and non-PE pregnant women and can be used as diagnostic and screening tests.[15-19] However, our study did not yield any supporting evidence, as there were no statistical differences in the mentioned hematological parameters between the groups.

On the other hand, there was evidence of increased RDW and NLR but decreased relative lymphocyte count in PE women compared with non-PE pregnant women, which were found to be the potential diagnostic hematological markers of preeclampsia. This result is supported by evidence from studies reported by different authors, which showed that pregnant women with PE had significantly higher values of RDW and NLR, while in some women, relative lymphocyte counts were significantly decreased.[20–23] Apart from the classification of pregnant women as PE and non-PE, RDW has also shown a relationship with the severity of preeclampsia.[24] It is well recognized that abnormalities in the functional and physicochemical properties of red blood cells (RBCs) may underlie the defects that are strongly linked to hypertension, strokes, and other cardiovascular diseases. The underlying mechanisms responsible for the association between high RDW and hypertension are uncertain [25]. Similarly, the neutrophil/lymphocyte ratio (NLR) is a marker of systemic inflammation and endothelial dysfunction, which is recently being reported as a potential utility to predict/diagnose preeclampsia. A systematic review and meta-analysis showed NLR has a predictive role for preeclampsia since inflammatory response is suggested to be bean important process in preeclampsia.[26] Researchers have found that the severe inflammation in PE is often accompanied by neutrophil activation and develops simultaneously with the clinical symptoms in a patient.[27] Regarding lymphocyte count, there is a decrease during pregnancy through the first and second trimesters and but increases duringthe third trimester as there is inactivation of the innate immunity specially lymphocytes.[28, 29]

Similarly, in this study there was pronounced statistically significant lymphocyte count decrement among PE groups compared with non-PE pregnant women.

CONCLUSION

RDW, NLR, and lymphocyte count can be potential candidates for the diagnosis and screening of preeclampsia, as these tests are easily available and cost-effective. They are performed routinely in the laboratory. However, the robustness of the utilities

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should be tested with prospective long-run studies assessing changes present in each trimester.

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