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Evaluation of the Complete Blood Count Parameters in Pregnant Women Presenting With Preeclampsia in AL-Gumhori Hospital Sana'a, Yemen.

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Abstract

Background and objectives: Preeclampsia (PE) is a pregnancy-specific hypertensive disorder that contributes to maternal and fetal morbidity and mortality. This study aimed to evaluate complete blood count (CBC) abnormalities in pre-eclamptic women at Al-Gomhori Hospital, Sana'a, Yemen.

Methods: A cross-sectional study was conducted from July to December 2024, including 140 pregnant women (70 women with preeclampsia and 70 controls with normal pregnancies). Blood samples were analyzed using a Sysmex XN-550 automated hematology analyzer. Statistical analysis was performed using SPSS version 27 with $p<0.05$ as the significance level.

Results: The mean hemoglobin (HGB) and hematocrit (HCT) levels were slightly but not significantly higher in the preeclampsia group compared to the contrrol (p=0.069 and p=0.445, respectively). However, the red blood cell (RBC) count was significantly higher in preeclamptic women (4.5 10^{12}/L vs. 4.2 10^{12}/L, p=0.04). Mean corpuscular hemoglobin concentration (MCHC) was significantly elevated in preeclamptic patients (33.4% vs. 32.7%, p=0.01). The platelet count was significantly lower in preeclamptic women (197.9 10^{9}/L vs. 266.7 10^{9}/L, $p < 0.001$), with 24.3% having thrombocytopenia. Additionally, mean platelet volume (MPV) was significantly higher in preeclamptic patients (10.7 fL vs. 8.7 fL, $p < 0.001$). WBC counts were similar, but lymphocyte, monocyte, eosinophil, and basophil percentages were lower in the preeclamptic women.

Conclusion: Hematological changes, including thrombocytopenia, increased MPV, and elevated RBC and MCHC levels, were significant in preeclamptic women. These CBC parameters may be useful markers for the early detection and management of preeclampsia. Further research is required to explore the clinical implications of these findings.

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1. INTRODUCTION

Preeclampsia is a pregnancy-specific condition marked by the development of hypertension, along with either proteinuria or dysfunction of end organs occurring after the 20th week of gestation [1]. This condition stems from an abnormal vascular response during the implantation process, which leads to increased platelet aggregation, activation of the coagulation cascade, endothelial cell dysfunction, and elevated systemic vascular resistance

[2]. It is a significant contributor to both maternal and fetal morbidity and mortality [3]. Globally, preeclampsia complicates approximately 3% to 5% of all pregnancies [4, 5], whereas in developing countries, it affects between 1.8% and 16.7% of pregnancies [6]. In Yemen, preeclampsia and its complications are major factors affecting maternal mortality rates, positioning the country among those with the highest rates of maternal mortality worldwide [7]. The exact cause of pre-eclampsia remain unclear [8]. However, some researchers attribute this condition to placental ischemia, which can occur because of irregularities in placental positioning. This ischemic event may lead to the release of vasoactive substances into the maternal bloodstream, potentially triggering activation and dysfunction of maternal endothelial cells [9]. Abnormal placentation is thought to arise from insufficient invasion of the uterine tissue by fetal trophoblasts, which is necessary for remodeling uterine spiral arteries. This inadequate remodeling can result in placental ischemia or poor perfusion, leading to progressive ischemia or hypoxia, which are considered key mechanisms in the pathogenesis of pregnancy-related pre-eclampsia [10, 11]. An ischemic placenta may produce reactive oxygen species, that contribute to oxidative stress and dysfunction within the placenta. Additionally, this hypoxic environment can release chemokines, pro-inflammatory cytokines, and anti-angiogenic factors into maternal circulation, further exacerbating endothelial damage [12, 13]. Uncontrolled pre-eclampsia can lead to serious maternal complications, including multi-organ failure, eclampsia, seizures, hemorrhagic stroke, HELLP syndrome (characterized by hemolysis, elevated liver enzymes, and low platelet count), placental abruption, disseminated intravascular coagulation (DIC), and pulmonary edema [14]. Thrombocytopenia can occasionally become life-threatening. This condition may arise from increased platelet adhesion at sites of injured vascular endothelium, leading to increased platelet consumption and subsequent destruction [15]. In normal pregnancy, there is a hypercoagulable state characterized by elevated levels of coagulation factors and diminished natural anticoagulation mechanisms. This physiological change is designed to minimize excessive maternal blood loss during childbirth [16]. Women with preeclampsia may face a heightened risk of disseminated intravascular coagulation (DIC), which can lead to increased maternal morbidity and mortality [17]. This study aimed to address the gap in understanding the significance of abnormalities in complete blood count parameters associated with preeclampsia at Al-Gmohri Hospital in Sana'a, Yemen, by examining the levels of CBC parameters, and to identify early indicators that could help prevent complications and improve the management of preeclampsia.

2. METHODS

2.1. Study Design

This cross-sectional study was conducted at Al-Gmohri Hospital in Sana'a City, Yemen, from July to December 2024.

2.2. Sample Size

The sample size comprised 140 participants (pregnant women) calculated using the OpenEpi program (Version 2.3.1) with a 95% confidence level and 80% power. The expected frequency of preeclampsia in developing countries is estimated to be 10% [6].

2.3. Sampling

Participants were divided into two categories with a case-to-control ratio of 1:1. Thus, 70 women were identified as the preeclampsia group, while the other 70 women, comprising women with normal pregnancies, served as controls. Patients were diagnosed with preeclampsia based on the established diagnostic criteria. The condition was characterized by new-onset hypertension ($\geq$140/90 mmHg) and proteinuria ($\geq$300 mg/24 h or +1 by dipstick in the urine) after 20 weeks of gestation [18].

2.4. Data Collection

The data were collected using a questionnaire that included demographic information for each participant.

2.5. Sample Collection

A venous blood sample (3 ml) containing EDTA-K3 was obtained from each participant, gently mixed, and dispatched for laboratory analysis within 30 minutes. Complete blood count components were assessed using an automated blood cell counter, specifically a Sysmex XN-550 instrument.

2.6. Statistical Analysis

Data were entered into a computer, and all statistical analyses of the study results were conducted using the Statistical Package for the Social Sciences (SPSS) version 27.

2.7. Ethics Statements

Before providing written consent, all parents of the pregnant women participating in this study received a consent form along with details regarding the experimental methods. This study was initiated after receiving approval from the Postgraduate Studies and Scientific Research Council of Sana'a University.

3. RESULTS

Table (1) shows a comparison of hematological parameters between the preeclampsia and control groups. The mean age was significantly higher in the preeclampsia group (31.1±6.2 years) compared to the control group (26.8±5.3 years), with a p-value of 0.001, indicating a statistically significant difference between the two groups.

Table 1. Age distribution of preeclampsia and control

Parameters	Preeclampsia	Control	p-value
Age (years)	31.1±6.2	26.8±5.3	0.001

Table (2) presents a comparison of hematological parameters between the preeclampsia and control groups. The mean hemoglobin (HGB) levels were slightly higher in the preeclampsia group (11.6±1.9 g/dL) compared to the control group (11.1±1.3 g/dL), though the difference was not statistically significant (p=0.069). Similarly, hematocrit (HCT) levels were not significantly different between the groups (34.4±5.4% vs. 33.8±3.1%, p=0.445). Red blood cell (RBC) counts were significantly higher in the preeclampsia group (4.5±1.2 10^{12}/L) compared to the control group (4.2±0.4 10^{12}/L, p=0.04). The mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) levels were comparable between the two groups, with p-values of 0.117 and 0.810, respectively. However, the mean corpuscular hemoglobin concentration (MCHC) was significantly higher in the preeclampsia group (33.4±2.1%) than in the control group (32.7±1.5%, p=0.01). The red cell distribution width (RDW-CV) was slightly lower in the preeclampsia group (15.6±3.0%) than in the control group (16.4±2.5%), although the difference was not significant (p=0.07). White blood cell (WBC) counts were nearly identical between groups (10.2±4.1 10^9/L vs. 10.1±2.9 10^9/L, p=0.952). Among the differential white blood cell counts, neutrophil percentages were higher in the preeclampsia group (7.4±3.9%) than in the control group (6.6±3.3%), although the difference was not statistically significant (p=0.110). However, lymphocyte (2.1±0.81% vs. 2.6±0.72%, p < 0.001), monocyte (0.6±0.28% vs. 0.8±0.32%, p < 0.001), eosinophil (0.09±0.09% vs. 0.2±0.11%, p < 0.001), and basophil (0.03±0.02% vs. 0.5±0.4%, p=0.001) percentages were significantly lower in the preeclampsia group compared to the control group. Platelet (PLT) counts were significantly reduced in the preeclampsia group (197.9±70.9 10^9/L) compared to the control group (266.7±50.1 10^9/L, p < 0.001), indicating a potential association between thrombocytopenia and preeclampsia. Meanwhile, mean platelet volume (MPV) was significantly elevated in the preeclampsia group (10.7±1.2 fL) compared to the control group (8.7±1.1 fL, p < 0.001), suggesting altered platelet morphology in preeclamptic patients.

Table 2. CBC Parameters of preeclampsia and controls

Parameters	Preeclampsia	Control	p-value
HGB	11.6±1.9	11.1±1.3	0.069
HCT	34.4±5.4	33.8±3.1	0.445
RBCS	4.5±1.2	4.2±0.4	0.04
MCV	78.4±8.2	80.6±8.2	0.117
MCH	26.5±3.5	26.4±3.5	0.810
MCHC	33.4±2.1	32.7±1.5	0.01
RDW-CV	15.6±3.0	16.4±2.5	0.07
WBC	10.2±4.1	10.1±2.9	0.952
Neutrophil (%)	7.4±3.9	6.6±3.3	0.110
Lymphocyte (%)	2.1±0.81	2.6±0.72	< 0.001
Monocyte (%)	0.6±0.28	0.8±0.32	< 0.001
Eosinophil	0.09±0.09	0.2±0.11	< 0.001
Basophil	0.03±0.02	0.5±0.4	0.001
PLT	197.9±70.9	266.7±50.1	<0.001
MPV	10.7±1.2	8.7±1.1	<0.001

4. DISCUSSION

Many studies have indicated that CBC parameters can predict preeclampsia. However, most of these studies examined last trimester CBC results [19, 20, 21]. In addition, few studies have attempted to predict preeclampsia by examining CBC parameters during two different periods of pregnancy [22, 23] Many studies in the literature suggest that CBC parameters can help predict preeclampsia, with most studies focusing on the results of the last trimester results [19, 20, 21]. However, few studies have examined CBC parameters at different stages of pregnancy to predict preeclampsia [22, 23]. Our findings are consistent with these observations, with slightly higher hemoglobin levels in the preeclampsia group than in the control group, although the difference was not statistically significant. This aligns with the results of previous studies that reported minimal differences in hemoglobin levels between preeclamptic and normotensive pregnancies [24, 25]. We observed a significant increase in red blood cell (RBC) counts in preeclamptic women compared with controls. This finding suggests a possible hemoconcentration effect, as preeclampsia is typically associated with a reduced plasma volume. Such an increase in RBC count in preeclampsia could be linked to the vascular changes and reduced plasma volume observed in these women [26]. The mean corpuscular hemoglobin concentration (MCHC) was notably higher in the preeclampsia group, further supporting the notion of hemoconcentration in preeclampsia. This result is consistent with previous research, where MCHC levels were found to be elevated in women with severe preeclampsia compared to those with milder forms [27, 28, 29]. White blood cell (WBC) counts showed no significant difference between the groups, which is consistent with other studies [24, 25]. However, the percentage of neutrophils was higher in preeclamptic women with PE. This suggests a possible inflammatory response in preeclampsia, where neutrophils may contribute to vascular changes and hypertension associated with the condition [30] The percentages of lym-

phocytes, monocytes, eosinophils, and basophils were significantly lower in the preeclampsia group, indicating shifts in the immune response. The decrease in lymphocytes in preeclampsia could reflect a shift from Th2 to Th1 immune responses, which are linked to the reduced immune tolerance observed in these women [31, 32]. The reduction in eosinophils and basophils could also be attributed to immune system changes, where type 1 interferons play a role in apoptosis [33, 34, 35]. Thrombocytopenia was another significant finding in the preeclampsia group, with platelet counts significantly lower than those in controls. This decrease is likely linked to endothelial dysfunction and increased platelet activation and consumption, all of which contribute to thrombocytopenia in preeclampsia [30, 36, 37, 38, 39]. In addition, the mean platelet volume (MPV) was higher in the preeclamptic group, suggesting increased platelet activation, which is consistent with previous research. The increase in MPV may serve as an important marker for monitoring preeclampsia, especially given its association with platelet activation and dysfunction in this condition [40, 41, 42, 43, 26].

5. CONCLUSION

This study examined the CBC parameters in pregnant women with preeclampsia. The results showed higher hemoglobin, RBC count, and MCHC but lower platelet counts, indicating thrombocytopenia. White blood cell differentials were significantly lower and MPV was elevated, suggesting altered platelet morphology. These findings highlight that CBC is a valuable tool for the early detection and management of preeclampsia. Further research is needed to confirm these results and to explore the underlying mechanisms of these hematological changes.

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