Effect of Severe Maternal Preeclampsia on the Hematological Profile of Newborn in Baghdad Teaching Hospital

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ABSTRACT

Background: Preeclampsia affects a range of 2% to 8% of pregnancies globally. It may induce inadequate placental perfusion during pregnancy, resulting in insufficient blood flow to the fetus, which exposes the infant to hypoxia and disrupts neonatal hematopoietic stem cells. Aim of study: To evaluate the hematological disturbances in newborns of women with preeclampsia mothers. Patients and methods: The study has been conducted in the Obstetric Department and Labor Ward of Baghdad Teaching Hospital/ Medical City, Baghdad. The data was collected from the 1st of January 2024 to the 1st of November 2024. A total of 400 pregnant women were enrolled in this study; 200 pregnant women with pre-eclampsia (cases) and 200 normotensive pregnant women as controls. Results: patients diagnosed with preeclampsia exhibited significantly elevated levels of hemoglobin, total red blood cell count, hematocrit, mean corpuscular volume, and reticulocyte count. Whereas, cases demonstrated significantly lower total leukocyte count, neutrophil percentage, absolute neutrophil count, lymphocyte percentage and platelet count. Conclusion: Based on the findings of the current study, neonates born to mother of preeclampsia had significantly higher RBC count and lower WBC and platelet counts; and thus, they showed significantly higher risk for polycythemia, leukopenia, and thrombocytopenia.

KEYWORDS: Preeclampsia, eclampsia, fetal hematological profile, neonatal outcomes.

List of Abbreviations

Abbreviation	Definition
ACOG	American College of Obstetricians and Gynecologists
ANC	Absolute neutrophil count
APGAR	Appearance, Pulse, Grimace, Activity and Respiration
BMI	Body mass index
CBC	Complete blood count
EDTA	Ethylene diamine tetra acetate
fL	Femtoliter =10-15 liter
Hb	Hemoglobin
HbA	Adult hemoglobin/ hemoglobin A
HbF	Hemoglobin fetus
ICH	Intracranial hemorrhage
LMP	Last menstrual period
MCH	Mean corpuscular hemoglobin
MCHC	Mean corpuscular hemoglobin concentration
MCV	Mean corpuscular volume
NICU	Neonatal intensive care unit
PE	Preeclampsia
RBC	Red blood cells
SPSS	Statistical Package For Social Sciences
TLC	Total leukocyte count

WBC White blood cells.

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INTRODUCTION

Preeclampsia is a multisystem disorder of unknown etiology characterized by the development of hypertension to the extent of 140/90 mm Hg or more in normotensive and nonproteinuric woman. Some amount of edema is common in a normal pregnancy. Edema has been excluded from the diagnostic criteria unless it is pathological. The preeclampsia features may appear even before the 20th week of gestation as in cases of hydatidiform mole and acute polyhydramnios [1-2]. Hypertensive disorders during pregnancy lead to reduced placental perfusion and inadequate blood supply to the fetus, causing fetal exposure to hypoxia within the placenta. The hypoxic placenta secretes specific vasoactive substances into neonatal blood in reaction to this stress, influencing the hematological profiles of newborns [3]. This study was conducted aiming to evaluate the hematological disturbances in newborns of women with preeclampsia mothers.

PATIENTS AND METHODS

This case control study was conducted in the Obstetric Department and Labor Ward of Baghdad Teaching Hospital/ Medical City - Baghdad. The data was collected from the 1st of January 2024 to 1st of November 2024. A total of 400 pregnant women were enrolled in this study; 200 pregnant women with pre-eclampsia (cases) and 200 normotensive pregnant women as controls.

Inclusion criteria

Singleton pregnant women who met the ACOG criteria for the diagnosis of preeclampsia were included in the study. Healthy and normotensive pregnant women formed the control group.

Exclusion criteria

1. Women with chronic diseases (i.e. diabetes, heart failure, renal failure, liver disease, preexisting hypertension).
2. Women with active infection or febrile illness during delivery.
3. Neonatal infections.
4. Newborns with congenital anomalies.
5. Babies born to mothers with Rh incompatibility.

Ethical consideration

Verbal consent has been obtained from all participants before data collection. An official letter of approval has been obtained from the scientific committee of the scientific council of Obstetrics and Gynecology – Iraqi Board for Health Specializations and Baghdad Teaching Hospital.

Data collection

General and clinical information such as maternal age, parity, gestational age was determined by LMP and confirmed by early pregnancy ultrasound. Abdominal and obstetrical ultrasound (Philips HD 11 ultrasound machine) performed by radiologist at time of admission. Study patients underwent general examination, vital signs, abdominal and obstetric examination, and laboratory investigation were performed. The maternal data collected was the following: age, chronic diseases, drug usage, parity, blood group, gestational age, interventional procedures during pregnancy, mode of delivery, birth weight of the newborn, gender of the newborn, Apgar scores at the first and fifth minutes and resuscitation status were recorded. The diagnosis of PE was done according to the ACOG criteria (Practice bulletin 222) [4]. After delivery, approximately three milliliters of umbilical cord blood specimens were obtained from the clamped umbilical cord. The umbilical cord was clamped immediately and cleaned with 70% alcohol and an iodine swab to remove maternal blood and contaminants. After cleaning, the cord blood sample was collected by the syringe method. Then the sample was transferred into a test tube containing di potassium Ethylene Diamine Tetra Acetate (EDTA) and gently mixed to prevent clotting. The cord blood specimen was transported to the hematology laboratory for a complete blood count (CBC) analysis using (5 diff – Auto hematology analyzer, Model BH-6180).

The following definitions for neonatal cord blood abnormalities were used:

Thrombocytopenia: The platelet count of newborns is less than 132.7×10^9 /L [5].
Anemia: The level of Hgb of newborns is less than 13.3 g/dl [6].
Polycythemia: The level of hematocrit of newborns is greater than 58.1% [6].
Leukopenia: The TLC of newborns is less than 7.64×10^9 /L [6].
Neutropenia: The ANC of newborns is less than 2.96×10^9 /L [6].

Data entry and analysis

Data entry was done using Microsoft Excel 2019. Data was recorded into different quantitative and qualitative variables for the purpose of analysis. Analysis was done using statistical package for social sciences (SPSS version 26). Data was summarized using measures of frequency (mean), dispersion (standard deviation), tables and graphs. A two-tailed p value of less than or equal to 0.05 was assigned as a criterion for declaring statistical significance.

RESULTS

A total number of 400 participants were included in the study sample (200 cases and 200 controls). A statistically significant

difference was detected between both study groups regarding maternal age, BMI, and residence; as shown in table (1).

Table 1: Comparison of basic characteristics of both study groups.

Parameter	**Group**		**P value**
	Cases (n=200)	Controls (n=200)	
Maternal age			
Mean ± SD	33.5 ± 8.4	28.4 ± 7.5	<0.001
BMI (kg/m^2)			
Normal weight (18.5-24.9)	107	136	<0.001
	53.5%	68.0%	
Overweight (25.0-29.9)	64	57	
	32.0%	28.5%	
Obese (≥30)	29	7	
	14.5%	3.5%	
Mean ± SD	26.4 ± 6.3	24.1 ± 5.3	
Residence			
Urban	115	156	<0.001
	57.5%	78.0%	
Rural	85	44	
	42.5%	22.0%	
Occupational status			
Employed	76	78	0.918
	38.0%	39.0%	
Unemployed	124	122	
	62.0%	61.0%	

Table (2) shows that patients with preeclampsia had significantly lower gestational age at delivery than controls.

Table 2: Comparison of obstetric characteristics between both study groups.

Parameter	**Group**		**P value**
	Cases (n=200)	Controls (n=200)	
Parity			
Primiparous	94	63	<0.001
	47.0%	31.5%	
2-4 children	69	67	
	34.5%	33.5%	
>4 children	37	70	
	18.5%	35.0%	
Gestational age at delivery			
Mean ± SD	34.5 ± 2.61	37.22 ± 1.84	0.003

Table (3) shows a statistically significant difference between both study groups regarding mode of delivery, birth weight, 1st min APGAR score, 5th min. APGAR score, and the rate and duration NICU admission.

Table 3. Comparison of neonatal characteristics between both study groups.

Parameter	Group		P value
	Cases (n=200)	Controls (n=200)	
Neonatal sex			
Male	93	104	0.317
	46.5%	52.0%	
Female	107	96	
	53.5%	48.0%	
Mode of delivery			
C/S	174	34	<0.001
	87.0%	17.0%	
vaginal delivery	26	166	
	13.0%	83.0%	
Birth weight (grams)			
Mean ± SD	2663.7 ± 357.1	3531.7 ± 368.0	<0.001
APGAR at 1 min			
Mean ± SD	5.4 ± 3.1	8.9 ± 0.4	<0.001
APGAR at 5 min			
Mean ± SD	6.7 ± 2.0	9.4 ± 0.4	<0.001
NICU admission			
Yes	142	21	<0.001
	71.0%	10.5%	
No	58	179	
	29.0%	89.5%	
Need for CPAP			
Yes	102	11	<0.001
	51.0%	5.5%	
No	98	189	
	49.0%	94.5%	
Duration of admission at NICU (days)	7.3 ± 4.7	3.8 ± 3.5	<0.001

Table (4) reveals that patients diagnosed with preeclampsia exhibited significantly elevated levels of hemoglobin, total red blood cell count, hematocrit, mean corpuscular volume, and reticulocyte count. Whereas, cases demonstrated significantly lower total leukocyte count, neutrophil percentage, absolute neutrophil count, lymphocyte percentage, and platelet count.

Table 4: Comparison of fetal hematological profile between both study groups.

Parameter	Group	P value

	Cases	Controls	
Red blood cells			
Hb (g/dl)	18.2 ± 2.03	13.3 ± 3.53	<0.001
RBC (x 10^6/mm^3)	5.53 ± 0.73	4.18 ± 0.80	<0.001
Hematocrit (%)	56.3 ± 5.3	42.6 ± 3.1	<0.001
MCV (fl)	111.6 ± 3.8	106.15 ± 1.67	<0.001
MCH (pg)	37.1 ± 2.87	36.8 ± 1.47	0.749
MCHC (g/dl)	32.85 ± 0.83	33.37 ± 1.02	0.846
Reticulocytes (%)	8.53 ± 3.01	2.71 ± 0.63	<0.001
White blood cells			
Total leukocyte count $X10^9$	7.495 ± 0.362	13.036 ± 0.849	<0.001
Neutrophils (%)	42.4 ± 4.38	49.7 ± 2.04	<0.001
Absolute neutrophil count $X10^9$	4.946.15 ± 0.374	9.735 ± 0.453	<0.001
Lymphocytes (%)	41.83 ± 4.39	47.85 ± 3.85	<0.001
Platelets			
Platelet count ($x10^3$/mm^3)	127.5 ± 36.4	214.5 ± 61.89	<0.001

Table (5) illustrates that cases had significantly lower rates of anemia, whereas they had significantly higher rates of polycythemia, thrombocytopenia, leukopenia, neutropenia and lymphopenia.

Table 5. Comparison of rate of hematological abnormalities between both study groups.

Parameter	**Group**		**P value**
	Cases (n=200)	Controls (n=200)	
Anemia			
Yes	9	26	0.004
	4.5%	13.0%	
No	191	174	
	95.5%	87.0%	
Polycythemia			
Yes	23	3	<0.001
	11.5%	1.5%	
No	177	197	
	88.5%	98.5%	
Thrombocytopenia			
Yes	53	17	<0.001
	26.5%	8.5%	
No	147	183	
	73.5%	91.5%	
Leukopenia			

Yes	33	16	0.014
	16.5%	8.0%	
No	167	184	
	83.5%	92.0%	
Neutropenia			
Yes	29	15	0.037
	14.5%	7.5%	
No	171	185	
	85.5%	92.5%	
Lymphopenia			
Yes	27	13	0.029
	13.5%	6.5%	
No	173	187	
	86.5%	93.5%	

DISCUSSION

The current study also found that older age and higher pre-pregnancy BMI were significant risk factors for preeclampsia, table (1). These findings are not surprising given that older maternal age and higher BMI are established risk factors for preeclampsia. In concordance with the findings of the current study, a large scale study by Sun et al., who included 6218 pregnant women and found that advanced maternal age and maternal pre-pregnancy overweight/obesity were associated with 1.76 and 1.71 higher risk for pre-eclampsia [7]. The present study also found that primiparity was also associated with preeclampsia, table (2). A systematic review by Luo et al. analyzed 26 studies and found that Primiparous women had a significantly higher risk of preeclampsia, which was noted to be variably between 1.4 to 5.5 times higher in Primiparous women across different studies [8]. Another notable finding of the current study is that rural residence was significantly linked to higher rate of preeclampsia, table (1). This could be attributed to lower compliance with antenatal care, which is crucial in preventing the progression of gestational hypertension. The study by Khan et al. also reported that women from lower economic backgrounds, often residing in rural areas, were at a higher risk for developing preeclampsia [9]. The present study has shown that newborns of preeclamptic mothers had significantly higher RBC count, Hb, hematocrit, MCV, and reticulocyte count, tables (4-5). This finding is in concordance with the study by Mouna et al., reported that hemoglobin concentration showed a mean of 17.6 g/dl which was significantly higher compared to controls (14.6 g/dl). Moreover, their study also showed that cord blood RBC, hematocrit, and MCV were significantly higher among the cases group [10]. Bolat et al., also showed that RBC, hemoglobin, and reticulocyte percentage were significantly higher in the study group compared to the controls [11]. In the study performed by Al-Zahiri et al., It was found that maternal preeclampsia contributed to 26.5% of cases of neonatal polycythemia [12]. The mechanism for these findings is preeclampsia causes uteroplacental insufficiency, which leads to fetal hypoxia and stimulates erythropoiesis. Increasing the production of red blood cells leads to an increase in each of RBC count, Hb, and reticulocyte count. The increase in MCV is related to the increase in immature RBCs which have larger size [3]. Another reason for the increase in Hb may be that newborns of preeclamptic mothers have higher amounts of HbF than newborns from normotensive mothers. As a result, HbF has a greater affinity for oxygen than HbA and cells that have HbF have a higher oxygen affinity and the benefit of drawing more oxygen from the mother's blood through the placenta [11], resulting in hypoxia and uteroplacental failure. Regarding WBC parameters, cases had significantly reduced neutrophils and lymphocytes compared to controls. Bolat et al. found that total leukocyte, neutrophil, lymphocyte, monocyte and eosinophil counts were lower in the study group compared to the controls [11]. Backes et al., reported that neonates delivered to women with preeclampsia have a 50% incidence of neutropenia and that neutropenia has a variable course, typically lasting days to weeks in affected infants [13]. In the study by Mosayebi Z et al., leucopenia was found in 28.5% of the babies which was more common in babies of gestational age of 32-37 weeks [14]. Mulatie et al., observed a notable increase in the prevalence of leukopenia 16.2% and neutropenia 14.9% among cases, as opposed to 11.7% and 4.5% among controls [6].The potential mechanism by which preeclampsia reduces total leukocyte count may involve uteroplacental insufficiency, leading to suppressed fetal myeloid bone marrow production [11]. This study demonstrated a statistically significant decrease in platelet count in newborns of preeclamptic women, as one in four cases exhibiting thrombocytopenia. Similar findings were reported by Albahadily et al. in Iraq [15], El Sayed et al. in Egypt [16] and Martani et al., in India [17]. This finding is extremely concerning, as even mild thrombocytopenia has been shown to significantly increase the risk of severe complications, such as intracranial hemorrhage (ICH) [18]. Newborns of women with preeclampsia are already at elevated risk of ICH due to prematurity, and the presence of thrombocytopenia further exacerbates this risk. Potential mechanisms encompass the inhibitory influence of fetal hypoxia on platelet synthesis. Thrombocytopenia may also arise from thrombocyte adherence to the injured endothelial area resulting from segmental vasospasm and vasodilation in the placenta of preeclamptic mothers [19]. In the current

study, neonates born to preeclamptic mothers had lower APGAR scores and higher rate of NICU admission and longer duration of admission than controls, table (3). These findings are in concordance with Afrasiabi et al., reported that preeclampsia significantly correlates with longer NICU stays. Neonates from preeclamptic mothers had a notably higher risk of being admitted to the NICU for seven days or more compared to those from normotensive mothers [20]. Mendola et al., found that infants born to mothers with preeclampsia had a 1.9-fold increased risk of NICU admission compared to those born to normotensive mothers [21].

CONCLUSIONS

Based on the findings of the current study, neonates born to mother of preeclampsia had significantly higher RBC count and lower WBC and platelet counts; and thus, they showed significantly higher risk for polycythemia, leukopenia, and thrombocytopenia.

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