



The Value of Mean Platelet Volume as a Predictor in Preeclampsia

Pirzha Luqman Siddik* Sallama Kamel Nasir**

Abstract

Background and Objectives: Preeclampsia, a pregnancy-specific disorder, is a major cause of fetal and maternal morbidity and mortality due to endothelial dysfunction and coagulation system activation. This study aimed to evaluate the complete blood counts and assess the mean platelet volume value in preeclamptic patients.

Methods: This retrospective -sectional study was carried out in Sulaimaniyah Maternity Teaching Hospital, in Kurdistan Region, Northern Iraq, for a period of one year from August 2022 to August 2023. A sample of 210 women was taken, 109 affected by Preeclampsia and 100 “normotensive” women the complete blood picture at the late 1st trimester and early 2nd trimester was reviewed for both groups and mean platelet volume was calculated and compared between the two groups.

Results: A significant difference was observed in the value of Mean Platelet Volume in early pregnancy of women with Preeclampsia compared to those of normotensive women, with a sensitivity of 68% a specificity of 63 %, and an overall accuracy of 66%, a p-value of 0.001. There were also significant associations between Intrauterine Growth Restriction formation and high Mean Platelet Volume of the 109 women with preeclampsia 27 of them had both Preeclampsia and intra formation. However, no significant differences were seen in the modes of delivery and parity.

Conclusion: The availability and low cost of a complete blood count make the detection of high Mean Platelet Volume a simple measure to eventually predict the development of Preeclampsia and thus leading to earlier treatment and interventions, making its complications less likely.

Keywords: Complete blood count, Intrauterine growth retardation, Mean Platelet Volume, Preeclampsia

*MBChB, KBMS, Obstetrics and Gynecology Trainee; Sulaimaniyah Maternity Teaching Hospital-Sulaimani, Kurdistan region, Iraq

**MbCHB, Iraqi and Arabic Board in Obstetrics and Gynecology, Assistant Professor in Obstetrics and Gynecology in Sulaimani Maternity Teaching Hospital, College of Medicine, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq. Email: sallam.nasir@univsul.edu.iq

Corresponding Author: Pirzha Luqman Siddik, Email Address: pirzhasiddik@yahoo.com

Introduction

Preeclampsia is best described as a pregnancy-specific syndrome that can affect nearly every organ system, usually associated with coagulation system activation and endothelial dysfunction.¹ Although It's more than just elevated blood pressure and proteinuria, proteinuria remains the main diagnostic criteria as it reflects the system-wide endothelial leak that characterizes preeclampsia syndrome.² It's a major cause of both maternal and fetal morbidity and mortality, affecting multiple organ systems, which may be reflected by thrombocytopenia, renal dysfunction, hepatocellular necrosis, central nervous system perturbations, and pulmonary edema.² Meanwhile, 98% of its complications are occurring in developing countries, also causing 10-25% of all perinatal losses.¹ If diagnosis can be made earlier, complications of the disease may be prevented and treated. The pathogenesis of Preeclampsia is completely related to the placenta, meaning that the presence of a fetus is not a prerequisite for its formation.³ Although the exact mechanism is unknown, it's been discovered from animal studies that the multi-organ failure is from the uteroplacental ischemia.⁴ The establishment of the ischemia in Preeclampsia progresses in two stages. Stage I is when the placental trophoblast invades the maternal uterine spiral arteries; in placentas prone to Preeclampsia, the transformation of the spiral arteries is impaired, with deficient trophoblast invasion into the uterine tissue, leading to narrowed maternal vessels and relative placental ischemia.³ These affected vessels are more prone to atherosclerosis, leading to further compromise in placental blood flow.³ First, the ischemia causes the release of vasoactive factors into the circulation, which gives rise to endothelial-mediated end-organ damage and the appearance of the condition, also known as stage II maternal syndrome.¹ Then,

the damaged endothelium comes into contact with platelets, leading to platelet aggregation, resulting in thrombocytopenia and excessive platelet formation.⁵ Platelet aggregation and activation usually occur physiologically in late pregnancy. However, women with Preeclampsia have increased platelet activation earlier in pregnancy, causing an enhancement in platelet synthesis.⁶ This rapid formation of platelets leads to the emergence of large-sized, young platelets into the circulation. Meanwhile, an indicator of the platelet size and proliferation kinetics is mean platelet volume, which is easily detectable biomaterial in a complete blood count.⁷ These larger platelets are more susceptible to aggregation and release of adhesion molecules, eventually prompting the development of hypertension and Preeclampsia through ischemia.⁸ Several studies have linked high MPV to the formation of hypertension and Preeclampsia. However, the results are still controversial and not proven. The availability of this test was taken into consideration since there were conflicting results in previous research. We studied the mean platelet volume in two groups and its relation to preeclampsia formation.

Patients and methods

The study is a retrospective cross-sectional study conducted in Sulaimani Maternity Teaching Hospital in Sulaymaniyah, Kurdistan region of Northern Iraq. Cases were collected from August 2022 to August 2023. The group reviewed were of preeclamptic women in the third trimester. Inclusion criteria included all women with Preeclampsia from 28 weeks and above "third trimester," regardless of age and body mass index. The excluded Criteria were women with pre-existing hypertension, gestational diabetes, co-existing blood disorders, and any autoimmune disorders. The ethical aspect of the study was fulfilled by documented approval from Kurdistan



Higher Council of Medical Specialties, and hospital authority was taken, along with patient consent. The preeclamptic women population of the study were interviewed, and data were taken. Mean Platelet Volume values were checked from a “complete blood count” investigation in either the late first trimester or early second -trimester of their current pregnancy, normal value range “7-11fl”. The information was collected using a questionnaire, which included “Age, Parity, residence, history of PET in previous pregnancies, whether this pregnancy was complicated by intrauterine growth retardation IUGR, the presence or absence of autoimmune or any co-existing diseases, their mean platelet volume value in early pregnancy, albumin in urine. The value of Mean platelet volume was checked for elevation to see whether it was elevated in early pregnancy of women with Preeclampsia. Data entry was performed using an Excel spreadsheet. Then, a statistical analysis was conducted using the SPSS

program, version 24.0 “IBM SPSS statistical package for social sciences.

Results

The study involved two hundred and nine women, where the mean platelet volume value was retrospectively taken from Maternity Teaching Hospital in Slemani, and compared. Of the total 209, 109 women were diagnosed with Preeclampsia in the third trimester and 100 healthy normotensive women in the same trimester. In Table (1), we can see significant differences in the age groups, with 60 preeclamptic women falling between 28-37 years as compared to younger “20 women” and older “29 women” age groups $P=0.002$. There were also significant differences between urban and Rural residences, with 74 women affected by Preeclampsia residing outside of the cities $P=0.046$. Furthermore, in Table (2), no significant differences were seen comparing parity “ $P=0.56$ ” or the outcome of the current pregnancy, either CS or Vaginal Delivery “ $P=0.01$ ”.

Table (1): Demographic characteristics of the studied groups

	PET		Normal		Total		p-value
Age							
Mean $\pm$ SD	33.1 $\pm$ 6.2		30.3 $\pm$ 6.4		31.7 $\pm$ 6.4		0.002
18 - 27 Years	20	18.35%	33	33.0%	53	25.4%	0.01
28 - 37 Years	60	55.05%	55	55.0%	115	55.0%	
38 - 47 Years	29	26.60%	12	12.0%	41	19.6%	
Residency							
Urban	35	32.11%	55	55.00%	90	43.06%	0.001
Rural	74	67.89%	45	45.00%	119	56.94%	
Total	109	100.0%	100	100.0%	209	100.0%	



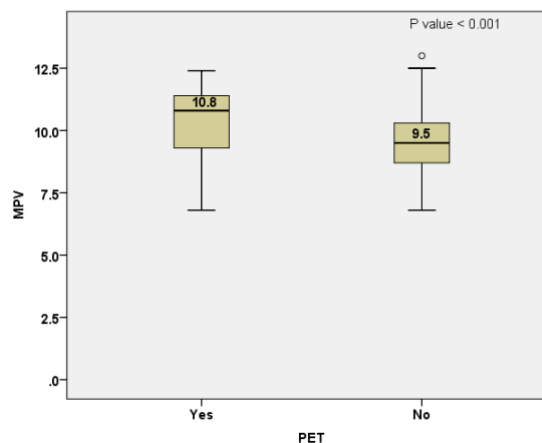
Table (2): Obstetrics history and outcomes

Obstetric history	PET		Normal		Total		p-value
Gravida							0.56
Primi	27	24.8%	21	21.0%	48	23.0%	
Two - Three	39	35.8%	43	43.0%	82	39.2%	
Four – Five	28	25.7%	27	27.0%	55	26.3%	
> Five	15	13.8%	9	9.0%	24	11.5%	
Para							0.23
Zero	36	33.0%	24	24.0%	60	28.7%	
One - Two	42	38.5%	50	50.0%	92	44.0%	
Three - Four	24	22.0%	23	23.0%	47	22.5%	
> Four	7	6.4%	3	3.0%	10	4.8%	
Previous pregnancy outcomes							0.01
NVD	17	15.6%	30	30.0%	47	22.5%	
CS	49	45.0%	46	46.0%	95	45.5%	
None	43	39.4%	24	24.0%	67	32.1%	
Total	109	100.0%	100	100.0%	209	100.0%	

In Table (3), it can be seen that 73% of preeclamptic women had no history of pregnancy induced hypertension “PIH” or preeclampsia “PET” in previous pregnancies, and only 14 % of cases had histories of two or more miscarriages.

Table (3): Other obstetrics history of the preeclamptic patients.

	Frequency	%
Pregnancy induced hypertension in Previous pregnancies		
Yes	29	26.6%
No	80	73.4%
Abortion		
None	74	67.9%
One	19	17.4%
Two or more	16	14.7%

**Figure (1):** The relation between Mean platelet Volume elevation and Preeclampsia

In the Figure (1) and table (4), we can observe the significant difference between women with Preeclampsia who had elevated MPV in the late first trimester and early second trimester, compared to the MPV of normotensive women, a median of 10.8 was taken in the PET group and a median of 9.5 in the normal group, with a p-value of “P=0.001”.



Table (4): The relation between elevated Mean platelet Volume and Preeclampsia

		Mean	Standard deviation	Median	IQR	P value
PET	Yes	10.37	1.36	10.8	2.2	< 0.001 *
	No (Normal)	9.56	1.25	9.5	1.7	
	Total	9.98	1.37	10.0	2.0	

Both independent t-test and Mann – Whitney test

Regarding the relationship between elevated mean platelet volume and IUGR formation, as seen in the following Table (5) a significant difference was seen; of the total

109 women who had Preeclampsia, 27 of them had both elevated mean platelet volume and IUGR formation in the third trimester, with a p-value of <0.0001.

Table (5): Intrauterine growth restriction in the preeclamptic group.

		Number	Mean platelet volume			p-value
			Mean	Median	Interquartile range	
Intrauterine growth retardation	Yes	27	10.06	11.4	0.8	< 0.001
	No	82	11.33	10.2	2.1	
Total		109	10.37	10.8	2.2	

Discussion

Preeclampsia remains one of the leading causes of maternal morbidity and mortality, affecting 5-8% of the world's population, which is estimated to be 8.5 million pregnant women, mainly in developing countries.⁹ While signs and symptoms of Preeclampsia usually develop at later gestations, after 20 weeks, the pathogenesis starts much earlier as a response to the endothelial damage that occurs due to ischemia, which also in the fetus causes IUGR.¹⁰ To predict these changes and prevent their complications, short and long-term morbidities, and mortality is crucial to every hospital.¹¹ One of the important parameters that change early in this response is the platelet.¹² In this study, we have taken the value of Mean platelet volume in relation to the development of Preeclampsia; the findings were highly significant “p<0.001”, where mean platelet volume was increased in late first trimester and early second trimester of preeclamptic

women when compared to normotensive women. These results were similar to the findings of Ahmet et al. Who also suggested a relationship between elevated MPV and Preeclampsia.¹³ Dunder et al. also found an association between high and increasing MPV in women with Preeclampsia in a longitudinal study in Turkey¹⁴, Oğlak et al. found a significant association between the MPV elevation in the first trimester in women who later developed Preeclampsia, similar in our study with terms of maturity of the fetus and hospitalized control group,¹⁵ additionally similar results are seen in numerous other studies, Boriboornhirunsarn et al,¹⁶ Marconi et al.¹⁷ All these studies go with the Behram et al., in explaining that chronic inflammation has a crucial role in early MPV formation.¹⁸ However, Monteith et al. found no potential use of MPV in the diagnosis of Preeclampsia.⁸ Temel et al. Found no changes in MPV and the presence or the severity of Preeclampsia.¹⁹ Through





the analysis of the study, we also found a significant association between intrauterine growth restriction formation and elevated MPV “ $P < 0.001$.” Although the etiology of IUGR is multifactorial, several studies, including ours, have linked the association of platelet activation and change, including an elevated MPV, with its formation. Contemplating the role of platelets in hemostasis regulation, thrombosis, and anticoagulation may lead to abnormalities in placental circulation.²⁰ Consistent with this is another retrospective study by Ciobanu et al., 2021,²¹ who found the potential use of MPV as a predictor of IUGR formation even in the absence of Preeclampsia.²⁰ Another study by Buyuk et al., 2021 found a significant association between elevated MPV and IUGR formation.²² In addition to this, a study by Shahgheibi et al. 2022, again found increased MPV in fetuses with IUGR.²⁰ The current study showed no significant association between women with zero parity as compared to multiparous women and the formation of Preeclampsia. Our findings are contradicted by the findings of Opitari et al., where the incidence of Preeclampsia in women with zero parity was 1.8 times that of multiparous women.^{23,24}

Conclusion

The present study found a significant association between Mean platelet volume and preeclampsia formation. Not to mention, there is an association between IUGR formation in the group with elevated MPV. In spite of the limitations, including sample size and the retrospective nature of the study, elevated MPV should be taken into consideration for better follow-up and earlier intervention.

Conflict of Interest

The author declares that he has no known competing interests.

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