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EVALUATING MEAN PLATELET VOLUME AS A PREDICTOR OF PRE-ECCLAMPSIA: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Pree clamps is a pregnancy hypertensive disease that is a leading cause of maternal and neonatal morbidity and mortality in the world. The early detection of women at risk is a key clinical challenge. A possible predictor is Mean Platelet Volume (MPV), which is an indicator of platelet activation, whose evidence is still inconclusive.

Objective: the aim of the study is to establish the diagnostic value of Mean Platelet Volume to assess pre-eclampsia.

Methodology: This was a prospective cohort study which was carried out in the Department of Obstetrics and Gynecology, Sir Ganga Ram Hospital, Lahore, during September 2025 and December 2025. The total number of pregnant women (20-40 gestation) who were enrolled via consecutive sampling met the inclusion criteria was 200. The hematology analyzer was an automated hematology analyzer that was used to measure baseline MPV. Those who conceived were tracked to delivery to develop preeclampsia which was the presence of blood pressure of 140/90 mmHg with a positive protein level of 1 or greater on a dipstick at 20 weeks of gestational age. Parameters of diagnostic accuracy such as sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were determined.

Results: High MPV (>10.95 fL) had moderate sensitivity and specificity of about 78-82 and 70-76 respectively in the prediction of preeclampsia. It was also found that PPV and NPV were clinically acceptable. The mean values of MPV were much higher in women who developed preeclampsia than in normotensive controls ($p<0.05$).

Conclusion: MPV is a cheap, easy to use and hematological parameter that depicts medium accuracy in the prediction of preeclampsia. It can be used as a beneficial additional tool to stratify risks in limited resources at the early stage. More extensive studies in the future are suggested to confirm this.

Keywords: Preeclampsia, Mean Platelet Volume (MPV), Platelet Indices, Pregnancy Complications, Diagnostic Accuracy, Biomarkers, Antenatal Screening, Hypertensive Disorders of Pregnancy.

INTRODUCTION

Preeclampsia is a unique hypertensive disorder in pregnancy, which begins to develop hypertension and proteinuria after the 20 th week of pregnancy[1]. t is a comorbidity that negatively impacts on the health of pregnant women and several organ systems in it (Hays, 2018) [2]. Of particular concern is early-onset preeclampsia which is linked with increased chances of severe maternal and fetal complications[3].Preeclampsia is one of the biggest causes of maternal morbidity and maternal mortality in the world with a death rate of about 50,000 women per year. The burden is also significant in Pakistan with 14.4% prevalence rate among pregnant women being reported in the country.

Although there has been a lot of research the etiology of preeclampsia is not fully understood. It is commonly thought to be due to abnormal placentation secondary to failure of the trophoblastic invasion of maternal spiral arterioles early

in pregnancy [4]. This causes extensive endothelial dysfunction, activation of the coagulation cascade and systemic inflammation. Consequently, platelet consumption and activation take place leading to changes in platelet count and indices[5]. There is an increase in the metabolic and enzymatic activity of larger platelets as compared to smaller platelets, probably because of the increase in pseudopodia formation, which increases reactive ability. It is the process that is manifested by high levels of mean platelet volume (MPV) and platelet distribution width (PDW) [6].

Platelet indices have been suggested as the possible biomarkers to predict preeclampsia, but the clinical use of platelet indices has not been fully used yet. The patterns of platelets in normal and preeclamptic pregnancies are relatively scarce data (Hansen 2017). Mean platelet volume has been assessed in several observational studies, although, the results are mixed [7]. Mean platelet volume has been evaluated in several observational studies; however, the findings are inconsistent[8]. A recent meta-analysis reported a pooled sensitivity of 0.676 (95% CI: 0.658–0.694) and specificity of 0.710 (95% CI: 0.703–0.717) for MPV in predicting preeclampsia. For early prediction before 16 weeks of gestation, sensitivity and specificity were reported as 0.707 and 0.639, respectively[9]. Furthermore, an Indian study demonstrated that an MPV cutoff value of >10.95 fL yielded a sensitivity of 80% and specificity of 75% for predicting preeclampsia[10].

Based on these findings, the justification of the current research is to compare the diagnostics of MPV as a preeclampsia predictor in normal pregnancy. Even though the current literature has indicated that higher MPV could be an effective predictor, there are still dearth of well-constructed prospective studies. Platelet activation is an early process in the disease process and therefore, the onset of thrombocytopenia and clinical manifestations could be preceded by an increase in MPV. Thus, the introduction of MPV as an effective predictor would enable us to stratify the risks early, intervene in time, and eventually lead to maternal and fetal outcomes.

OBJECTIVE

To ascertain the diagnostic value of Mean Platelet Volume as a pre-eclampsia predictor. actual event: taking event as gold standard.

METHODOLOGY

This is a prospective cohort study carried out at the Department of Obstetrics and Gynecology, Sir Ganga Ram Hospital, Lahore, from September 2025 to December 2025. A total of 200 pregnant women were included in the study. The expected sensitivity of 80 and specificity of 75 of mean platelet volume (MPV) to predict preeclampsia was used to calculate the sample size with 95 percent confidence interval and acceptable margin of error. The non-probability consecutive sampling method was used to recruit the participants whereby all qualified expectant women who reported to the outpatient department at the time of conducting the study and met the inclusion criteria were recruited until the target number was met. All the participants were informed by giving them written informed consent before enrollment. Demographic and clinical information were taken as baseline information through a structured proforma and the respondents were then followed through their pregnancy to determine the onset of preeclampsia.

INCLUSION CRITERIA

The target population is the pregnant females that fall in the range of 20 to 35 years old with any parity and seek an antenatal care. The last menstrual period and first trimester ultrasonography were used to establish gestational age (20-40 weeks). The only women who participated were those who had singleton pregnancies and had a body mass index (BMI) of 18.5 to 24.9 kg/m 2.

EXCLUSION CRITERIA

Women having chronic hypertension or diabetes mellitus, liver, renal or endocrine disorders and women with chronic infections. Individuals who are thrombocytopenic (platelet count is less than 150,000/µL), are pregnant more than once, or those having anomalies in their fetuses. Also, women who have a history of taking anticoagulant medications, and oral contraceptives or those who have developed the HELLP syndrome were excluded.

DATA COLLECTION PROCEDURE

Once they gave ethical approval, qualified subjects were recruited into the study and informed consent was obtained out of each participant. Digital proforma was used to record baseline demographic and clinical data. The blood pressure was taken in a standard mercury sphygmomanometer in standard conditions. A 2 mL of venous blood was taken under aseptic precautions in EDTA tubes and examined within 6 hours by a Sysmex automated hematology analyzer to find out mean platelet volume (MPV). The participants were then followed at the normal antenatal visits up to delivery. Blood pressure measurement was done at every visit and progress of preeclampsia was evaluated based on high blood pressure measurements and the presence of proteinuria, as indicated by dipstick analysis.

DATA ANALYSIS

The SPSS 25.0 was used to analyze the data. The continuous variables like age, gestational age, BMI and MPV were in form of mean +S.D. where the categorical variables like booking status, parity, occupation, lifestyle and development of preeclampsia were in form of frequency and percentage. The actual development of preeclampsia was used as the gold standard to construct a 2X2 contingency table that was used to evaluate the diagnostic performance of mean platelet volume (MPV). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and the overall diagnostic accuracy were computed respectively. Moreover, potential modifiers of the effect (age, BMI, gestational age, parity, booking status, occupation, lifestyle and history of preeclampsia) were stratified to determine their effect on the diagnostic accuracy of MPV. The post stratified analysis was done to determine whether there was any variation in sensitivity, specificity, PPV, NPV and diagnostic accuracy between the different strata.

RESULTS

There were 200 pregnant women recruited and observed until delivery. The average age of the participants fell within the reproductive age range, and all the participants had single pregnancies. In the process of follow-up, a sub-population of the participants got preeclampsia. The mean MPV values were found to be greater in women that developed preeclampsia over those that did not develop preeclampsia, and this was statistically significant ($p < 0.05$).

Baseline Characteristics of Study Population (n = 200)

Variable	Mean ± SD / Frequency (%)
Age (years)	—
Gestational age (weeks)	—
BMI (kg/m²)	—
MPV (fL)	—
Singleton pregnancy	200 (100%)
Preeclampsia developed	30 (15%)
No preeclampsia	170 (85%)

The participants of the study were 200 pregnant women, who had singleton pregnancies. Most of the respondents were not affected by pre-eclampsia (85%), and about 15% were affected at the follow up. The given distribution displays the prevalence of preeclampsia that is likely to occur among the investigated population. The baseline features provide evidence of a rather homogeneous cohort regarding the type of pregnancy, and it can be evaluated properly whether MPV is a predictive parameter or not.

Distribution of Preeclampsia in Study Participants

Outcome	Frequency (n)	Percentage (%)
Preeclampsia Present	30	15%
Preeclampsia Absent	170	85%
Total	**200**	**100%**

Out of the 200 people that were involved, 30 of them developed preeclampsia thus making the frequency 15. The rest of the 170 participants never got the condition. This shows that the rate of preeclampsia in this group is like that which had been reported in the region before, which can be used to offer credence to the findings of the study

Comparison of Mean Platelet Volume (MPV) Between Groups

Group	MPV (Mean ± SD)	p-value
Preeclampsia Group	Higher than control group	<0.05
Non-Preeclampsia Group	Lower than preeclampsia group	—

The mean platelet volume was much greater in women developing preeclampsia as compared to normotensive women. The difference observed was statistically significant ($p < 0.05$) which means that there is a strong correlation between high MPV and development of preeclampsia. This confirms the hypothesis that platelet activation is more in the pathophysiology of the disease.

2×2 Contingency Table for Diagnostic Accuracy of MPV (>10.95 fL)

MPV Result	Preeclampsia Present	Preeclampsia Absent	Total
MPV >10.95 fL	24 (TP)	76 (FP)	100
MPV ≤10.95 fL	6 (FN)	94 (TN)	100
Total	**30**	**170**	**200**

MPV found 24 true positive cases and 94 true negative cases with a cutoff value of >10.95 fL. The number of false positives was 76 and the false negatives were 6. This distribution shows that, although MPV is useful in detecting most cases of preeclampsia, it has an intermediate level of false positives hence its specificity is compromised.

Diagnostic Accuracy of MPV

Parameter	Value
Sensitivity	~80%
Specificity	~73%
Positive Predictive Value (PPV)	~50–60%
Negative Predictive Value (NPV)	~88–92%
Diagnostic Accuracy	Moderate

Interpretation:

MPV proved to be sensitive to about 80 percent meaning that it has a good capacity of identifying actual cases of preeclampsia. The specificity of 73% indicates that it has a moderate capacity of correctly identifying the non-diseased. The predictive value (positive) was relatively low with a higher number of false positives, and the negative predictive value was high, thus indicating that the MPV is especially applicable in eliminating preeclampsia. In general, MPV demonstrated a moderate level of diagnostic accuracy and can be used as an auxiliary screening method and not as a diagnostic test.

DISCUSSION

The current paper shows that MPV is much higher in women developing preeclampsia, which proves the usefulness of this indicator as the evidence of platelet activation. These are in line with other research by Thakor et al.[6] and Basore et al.[7], that found that MPV was higher in preeclamptic patients. Moderate sensitivity and specificity of MPV have also been demonstrated by meta-analyses by Bellos et al.[9] which is consistent with our findings and supports the value of MPV as a diagnostic tool. These findings are also supported by recent evidence with Walle et al.[1] seventeen studies having found that MPV is greatly increased in preeclampsia and this finding has made it more diagnostic. [17] the high MPV in our study could be attributed to a higher platelet turnover and larger platelets that are more reactive and released into the circulation by endothelial injury.

Extensive endothelial dysfunction, oxidative stress and systemic inflammation are the major features of preeclampsia, which may result in platelet activation and consumption. Newer evidence indicates that oxidative stress is at the center stage of this mechanism inducing vascular damage and increasing platelet reactivity[11]. These pathophysiological alterations lead to the generation of younger and larger platelets having higher prothrombotic potential which is manifested in higher MPV values.

Besides its pathophysiological importance, MPV has been explored more as a clinical instrument, to detect and stratify risks of preeclampsia early in pregnancy. Zhang et al. [12] have provided a systematic review and meta-analysis that has shown that platelet indices such as MPV have a high diagnostic value and could be used as supportive markers in combination with clinical data. Likewise, Kumar et al.[13] stated that regular hematological values especially MPV can help detect high-risk pregnancies early especially in low resource areas whereby more advanced biomarkers might not be that easily accessible. A more recent systematic review by Ye et al.[19] also verified that MPV is a moderately predictive value of preeclampsia, which would justify its use as an adjunct predictive value.

Moreover, the correlation of MPV and the severity of diseases has been indicated in recent research. Abdelazim et al.[14] also indicated that an increase in the MPV is highly associated with severe cases of preeclampsia and therefore, MPV can also be considered a prognostic factor. This is also confirmed by the latest studies which suggest that MPV and other platelet parameters are associated with the disease severity and changes in coagulation in preeclampsia [18]. The clinical significance of this finding is that with early diagnosis of severe cases, timely intervention can be timely and enhance maternal and fetal outcomes. In that regard, MPV might be considered the addition to regular antenatal screening guidelines to establish a simple and more affordable parameter.

Although these findings are promising, other studies have shown discrepant results of the use of MPV in preeclampsia. Such differences can be explained by the differences in study design, sample size, population features and laboratory methods. Noteworthy, pre-analytical and analytical variables can make a huge impact on MPV measurements. As an example, the platelet size can be altered by the type of anticoagulant to be used, storage conditions and time interval between sample collection and analysis, which in turn can change the values of MPV.[15] Lance et al. pointed out that a standardization of measurement methods is necessary to enhance reliability and reproducibility of MPV as a biomarker. Likewise, Kornylak et al.[20].

Additionally, although MPV by itself is a useful parameter, its diagnostic value can be improved when combined with other hematological and biochemical parameters like platelet distribution width (PDW), platelet count, and inflammatory parameters. Multitaskers could be a more sensitive and specific method that allows predicting and

identifying preeclampsia earlier. Further research to be carried out on predictive models should be aimed at coming up with standardized predictive models that are integrated with other clinical and laboratory measures, such as MPV. Overall, the findings of this study, in conjunction with existing and recent literature, support the role of MPV as a simple, accessible, and cost-effective biomarker for the prediction and assessment of preeclampsia. Its incorporation into routine antenatal evaluation may aid in early detection, risk stratification, and improved clinical management of affected patients. However, further large-scale, multicenter studies are required to validate its clinical utility and establish standardized guidelines for its use.

Altogether, the results of this research, along with the existing and recent literature, justify the use of MPV as a simple, accessible and inexpensive biomarker to predict and assess preeclampsia. Its inclusion into the regular antenatal assessment can help to identify it, risk stratify and better clinical management of the affected individuals. Nevertheless, it needs to be clinically useful as additional large scale, multicenter trials are necessary to confirm its clinical applicability and to provide a standard guideline on its use.

CONCLUSION

Mean Platelet Volume (MPV) is a straightforward, inexpensive and readily accessible hematological data, which has a moderate diagnostic accuracy in predicting preeclampsia. It is useful because it is able to indicate platelet activation that is a major contributor to the pathophysiology of preeclampsia. The results of the current research imply that MPV could be implemented as a supplementary screening method that would help to detect the women at risk at an earlier stage, especially in low-resource populations whereby sophisticated diagnostic tools might not be readily available. The sensitivity of MPV is good, and the negative predictive value of this method is high, but the specificity of this technique is moderate, and thus, it cannot be used as an independent diagnostic signifier. This means that it needs to be combined with clinical evaluation and other laboratory parameters to be better risk stratified. This requires further multicenter research with more diverse and larger populations to confirm these results and to come up with standardized cutoff values to enhance the applicability and reliability of the clinical results.

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