

Prospective Observational Study of Mean Platelet Volume and Other Platelet Indices in Preeclampsia and Effects on Maternal and Perinatal Outcome in a Tertiary Care Referral Centre

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KEYWORDS

Preeclampsia;
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Platelet Indices;
Platelet distribution
width; Mean platelet
volume; Platelet
Count;
Haematological
Parameters.

ABSTRACT

Background and Objectives: Preeclampsia is an obstetric disorder that affects 6-8% pregnancies worldwide. Thrombocytopenia is the common hematological abnormality seen in Preeclampsia & Eclampsia. The tests like PT, APTT, TT and fibronectin level are more sensitive but are expensive and time consuming. Platelet indices like MPV, PC and PDW are inexpensive and derived from routine blood investigations and widespread availability of tests

Materials and Methods: This is a Prospective comparative study conducted on 120 pregnant women who were meeting inclusion and exclusion criteria from 20 to 28 weeks of gestation. Out of 120 patients 60 patients with Preeclampsia of different severity were matched with 60 patients of healthy normotensive pregnant women who served as case (n=60) and control (n=60) respectively. At each scheduled antenatal visit subsequently 20-28 weeks (visit 1), 29-32 weeks (visit 2), 33-36 weeks (visit 3), and 37-delivery (visit 4) samples were drawn for platelet indices (MPV, PC, PDW) in EDTA vial and the serial record of these indices was maintained. Effect of deranged platelet indices on foeto-maternal outcome was another aim of the study. Feto-maternal outcome was noted and compiled.

Results: In case group majority were Primigravida 37 patients accounting for 61.7%. All platelet indices were found deranged in the PE group. Platelet count decreased significantly from 2.4 ± 0.3 lakhs/cumm on first visit to 1.5 ± 0.4 lakhs/cumm before delivery while platelet distribution width (PDW) and mean platelet volume (MPV) increased from 13.2fl to 16.9fl and 9.5 fl to 12.2 fl respectively. MPV increased significantly with increasing PE severity ($P < 0.05$), it was significantly higher in cases with poor foetal or maternal outcome.

Conclusion: Our study proves that Platelet indices can play a significant role in earlier identification of PE and signal intervention to prevent future complications. MPV among three indices was found to be more sensitive than others to be linked to feto-maternal outcome.

1. Introduction

Preeclampsia is an obstetric disorder that affects 6-8% pregnancies worldwide. Preeclampsia has high morbidity & mortality¹. Till date, there is no effective treatment for Preeclampsia, other than termination of pregnancy². A reliable predictor of Preeclampsia could therefore play an important role in early prevention of complications like Placental Abruption, HELLP Syndrome, Eclampsia and Feto-Maternal distress. Among the hematological profiles that change in pre-eclampsia and eclampsia, thrombocytopenia is the common abnormality. Degree of the thrombocytopenia increases with severity of the disease. The tests like prothrombin time, partial thromboplastin time, fibronectin level etc. are more sensitive but are expensive and time consuming and not suitable for routine purposes. Platelet volume indices (PVIs) are a group of parameters which are inexpensive to measure and are derived from routine blood counts, The mean platelet volume (MPV) and platelet distribution width (PDW) are the best validated and prominent of these and are attractive indices for research in clinical settings due to their widespread availability to clinicians³. Our study aimed to observe the serial changes in various PLT indices during the course of normal pregnancy, compare them in hypertensive pregnancies and find the correlation of changes in PLT indices in hypertensive pregnancies with increasing severity of PE so as to determine the potential value of PLT indices in predicting the onset and severity of PE possibly for early intervention.

2. Objectives

To observe serial changes in platelet indices in hypertensive pregnancies, find correlation with increasing severity of preeclampsia and determine the potential value of indices in predicting the onset and severity of preeclampsia. The effect of changing platelet indices in preeclampsia on fetomaternal outcome.

3. Materials and Methodology

Study design: Prospective Observational Study.

Study period: November 2019 to June 2022

Place of study: Patients in Department of Obstetrics & Gynaecology at Rajarajeswari Medical College and Hospital, Bangalore.

Sample size: 120 patients,

CASES are patients who are newly diagnosed Gestational hypertensive patients who are detected for the first time during 20 – 28 weeks of gestation & who fits into inclusion and exclusion criteria.

CONTROLS are the normotensive pregnant women of 20-28 weeks of gestation and who did not further develop any other comorbidities. When a normotensive pregnant woman develops new comorbidities which alter the platelet indices they were excluded from study because they will alter the platelet indices results.

- Control- 60 (Normotensive Pregnant women)
- Case – 60 (Hypertensive Pregnant women)

All the patients would be followed up from 20-28 weeks of gestation till delivery.

Investigation used: Complete Blood Count sample collected in EDTA vial and run in SYSMEX XN 1000 machine. It is done in 4 Antenatal visits starting 1st visit between 20 – 28 weeks upto delivery for both Hypertensive women and Normotensive pregnant women.

A total of 150 patients of 20 – 28 weeks of gestation are selected out of which only 120 patients could be followed up till the delivery.

30 of the patients were excluded due to following causes- 8 of the patients developed diabetes, 6 patients developed hypothyroidism, one patient developed dengue fever, 9 of them had preterm deliveries & 6 of them due to loss of follow up.

- Out of 120 patients – 60 were cases and 60 were control.

After informed consent, a detailed history was taken, general examination was done and blood was drawn for CBC in EDTA vial for platelet indices during all the four visits: 20-28 weeks, 29-32 weeks, 33-36 weeks and 37 weeks till delivery and sent to laboratory.

All the serial reports of PC, MPV & PDW were collected in each visit and data charting was maintained, tabulated & a comparative analysis of the above parameters between the two groups were made.

4. Results

The mean age of the Case group was 24.7 years, while the Control group had a mean age of 25.6 years, indicating that the two study groups were age-matched. Among the 60 individuals in the PE group, 35 were overweight (58.3%) and 21 were obese (35%). In contrast, the majority of the Control group had a normal BMI, with only 2 participants being obese (3.3%). Regarding parity, 37 of the 60 individuals in the PE group were nulliparous, accounting for 61.7%. In the Control group, only 16 out of 60 were nulliparous, representing 26.7%. The difference between groups was statistically significant, with a p-value of <0.01 based on the Chi-Square test.

Table 1: Platelet Count in Cases and Controls

Platelet count (lakhs/cumm)	Cases	Control	Total	P Value
VISIT 1	2.46±0.3	2.62±0.35	2.54±0.34	0.009**
VISIT 2	2.2±0.46	2.29±0.52	2.25±0.49	0.355

Platelet count (lakhs/cumm)	Cases	Control	Total	P Value
VISIT 3	1.94±0.45	2.44±0.47	2.19±0.52	<0.001**
VISIT 4	1.59±0.48	2.73±0.44	2.16±0.73	<0.001**

It was observed that at each visit in the case group platelet count continued to fall significantly from 2.46±0.3 lakhs/cumm on visit 1 to 1.59±0.48 lakhs/cumm before delivery. On the contrary mildly rising trend of Platelet count was noticeable in the Control group from 2.6 ± 0.3 lakhs/cumm on Visit 1 to 2.7 ± 0.4 lakhs/cumm.

Table 2: Mean Platelet Volume in cases and controls

MPV (fl)	Cases	Control	Total	P Value
VISIT 1	9.52±1.35	8.56±0.97	9.03±1.27	<0.001**
VISIT 2	10.32±1.29	9.87±1.83	10.09±1.59	0.129
VISIT 3	11.24±0.98	9.84±1.37	10.54±1.38	<0.001**
VISIT 4	12.25±1	10.08±1.26	11.17±1.57	<0.001**

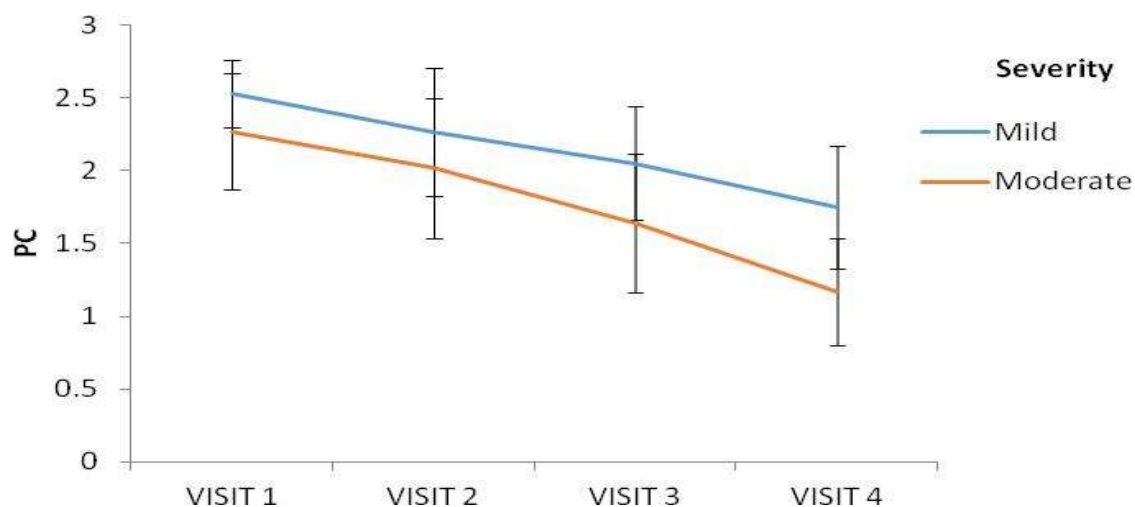
The Mean Platelet Volume has been observed to be little on the higher side on first visit in Case group and has continuously raised from 9.5 fL at visit 1 to 12.2 fL during delivery in the Case group. On the contrary the Mean Platelet Volume in Control group has also increased from 8.5 fL to 10.08 fL but it is less when compared to Case group.

Table 3: Platelet Distribution width in cases and controls

Platelet Distribution width (%)	Cases	Control	Total	P Value
VISIT 1	13.22±1.97	9.45±1.63	11.33±2.61	<0.001**
VISIT 2	13.58±1.83	9.72±2.37	11.65±2.86	<0.001**
VISIT 3	14.32±1.71	9.36±1.95	11.84±3.09	<0.001**
VISIT 4	16.95±1.35	9.49±1.58	13.22±4.02	<0.001**

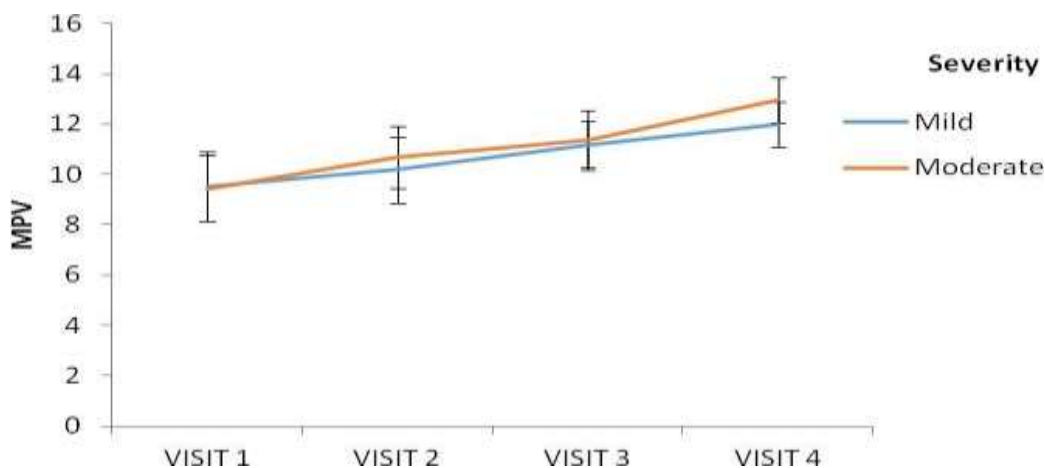
The Platelet Distribution Width has been observed to be little on higher side on first visit in Case group and has continuously raised from 13.2 % at visit 1 to 16.9% during delivery in the Case group. On the contrary the Platelet Distribution Width in Control group was almost constant throughout pregnancy and is statistically significant when compared to Case group.

Correlation of Platelet Indices with Severity of Pih

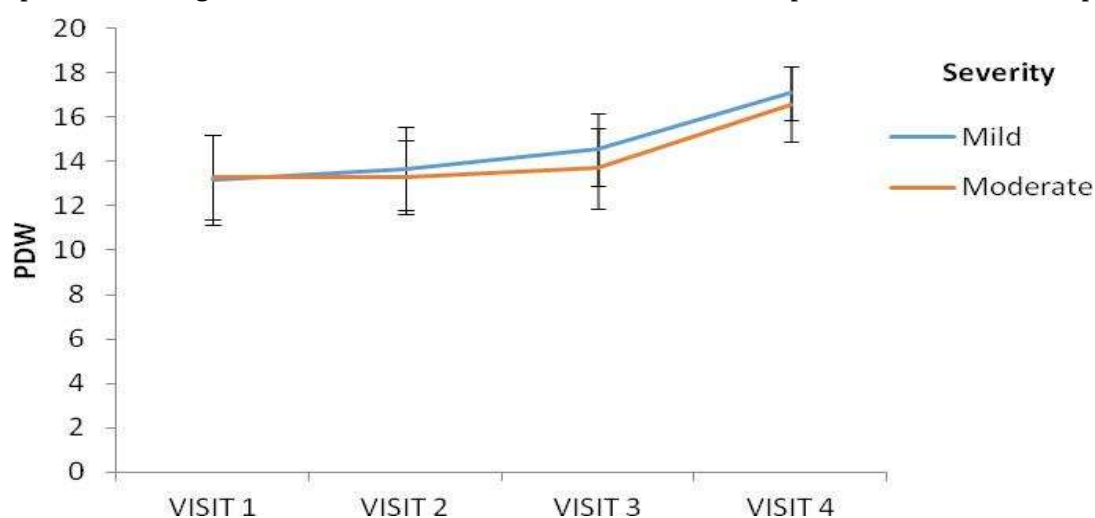


Graph 1: Falling trend of Platelet count in Mild Preeclampsia Vs Severe Preeclampsia

In Mild Preeclamptic Cases Platelet count has fallen from 2.5 lakhs to 1.7 lakhs whereas in Severe Cases Platelet Count has fallen from 2.2 lakhs to 1.1 lakhs, which is statistically significant.



Graph 2: Increasing trend of Mean Platelet Volume in Mild Preeclampsia Vs Severe Preeclampsia



Graph 3: Raising trend of Platelet Distribution Width in Mild Preeclampsia Vs Severe Preeclampsia

Table 4: List of Complications Seen in Cases and Control Groups

Complications	Cases	Control	Total
No	41(68.3%)	52(86.7%)	93(77.5%)
Yes	19(31.7%)	8(13.3%)	27(22.5%)
Hellp Syndrome	4(6.7%)	0(0%)	4(3.3%)
Placenta Previa	2(3.3%)	2(3.3%)	4(3.3%)
Aki	2(3.3%)	0(0%)	2(1.7%)
Mgso4 Toxicity	1(1.7%)	0(0%)	1(0.8%)
Anemia	5(8.3%)	4(6.7%)	9(7.5%)
Abruptio Placenta	2(3.4%)	1(1.7%)	3(2.5%)
Postpartum Haemorrhage	3(5%)	1(1.7%)	4(3.3%)
Total	60(100%)	60(100%)	120(100%)

Maximum number of complications seen in Case group P value of 0.034 was derived which is significant.

Table 5: Baby weight in Case and Control group

BABY WT	Cases	Control	Total
<2.5	13(21.7%)	2(3.3%)	15(12.5%)
>2.5	47(78.3%)	58(96.7%)	105(87.5%)
Total	60(100%)	60(100%)	120(100%)
Mean $\pm$ SD	2.64 $\pm$ 0.28	2.85 $\pm$ 0.23	2.74 $\pm$ 0.28

Good baby weight is significantly high in control than the case group and P value of <0.001 is obtained.

Table 6: Neonatal complications seen in case and control

Complications	Cases	Control	Total
No	40(66.7%)	52(86.7%)	92(76.7%)
Yes	20(33.3%)	8(13.3%)	28(23.3%)
Iugr	10(16.7%)	2(3.3%)	12(10%)
Msl	3(5%)	0(0%)	3(2.5%)
Respiratory Distress	3(5%)	2(3.3%)	5(4.2%)
Phototherapy	4(6.7%)	3(5%)	7(5.8%)
Recurrent Phototherapy	1(1.7%)	0(0%)	1(0.8%)
Nicu Admission	3(5%)	0(0%)	3(2.5%)
Shoulder Dystocia	0(0%)	1(1.7%)	1(0.8%)
Total	60(100%)	60(100%)	120(100%)

Neonatal complications were significantly high in the case group accounting for 33 % of the case group with **P value of 0.017** which is significant.

There were 3 NICU admissions also seen in Case group accounting for 5% of complications of case group.

5. Discussion

In the present study, values of hematological Platelet count and Platelet indices – MPV and PDW obtained from the blood samples of cases and controls were analysed and compared. As Preeclampsia is one of the leading causes of maternal and fetal morbidity and mortality worldwide, the assessment of hematological parameters helps in knowing a pregnant woman's risk of developing PE and tailoring her antenatal care according to the need.^{4,5}

Young women are more susceptible to PE, whereas older women are at a higher risk of developing PreEclampsia¹Maximum number of PIH cases (50%) in the present study were in the second decade. While the mean age of occurrence of PE was 24.73 years, which correlated with studies by Altinbas et al and Dogru HY et al, the mean age of occurrence of severe PE was 25.85 years. Nulliparous women are at a higher risk of developing PE⁵Majority of the cases in the present study were primigravida (61.7%)

Platelet activation in normal pregnancy and PE leads to thrombocytopenia. However, further decrease in the platelet count in preeclamptic patients is due to increased platelet consumption because of unchecked intravascular platelet activation and deposition of fibrin⁶.More than half of the cases (50.6%) in the present study had thrombocytopenia. PIH cases had a lower platelet count (mean = 2.0 lakhs/cumm) when compared to the controls (mean = 2.47 lakhs/cumm), which was statistically significant with a p value of < 0.001. This finding was similar to all the studies shown Parkash M⁷ Sultana et al⁸.Platelet count has an association with increasing severity of PI⁹. Degree of thrombocytopenia is said to determine the severity of PIH¹.Likewise, in the present study, a lower platelet count was observed in the cases of severe PE (mean = 1.7 lakhs/cumm) when compared to cases of mild PE (mean = 2.1 lakhs/cumm).

Platelet indices are simple, economical and rapid investigations, which aid in early detection and monitoring of the PIH cases¹⁰. These can be raised even before an increase in the BP, which can alert the obstetrician of an impending disease. Platelet indices are inversely proportional to the platelet count and are considered to be potential predictive markers of severity of PE in early pregnancy¹¹. A higher MPV was seen in PIH cases (mean = 10.8 fl) when compared to the controls (mean = 9.5 fl), which was statistically significant with a p value of <0.001. This was in concordance with all the studies Kanat-Pektas et al⁴ Karateke et al¹⁰ Parkash M⁸. MPV was found to have an association with the severity of the disease. Cases of severe PE had a higher MPV (mean = 11.0) than those of mild PE (mean = 10.61). Mean platelet volume, a direct indicator of increased platelet synthesis and bone marrow function has proven to be more sensitive than PC in identifying altered platelet function in preeclampsia. The MPV was found elevated proportionally with the severity of PE. This fact has been noticed earlier by Dadhich et al, Yang et al, Vijya et al and Wael et al.

A higher PDW was observed in the cases (mean = 14.8 fl) when compared to the controls (mean = 9.4 fl), which was statistically significant with a p value of <0.001. This was similar to all the studies Karateke et al¹² Freitas et al¹³ Parkash M¹⁴. In my study there was no much difference in PDW in mild and severe cases. PDW was found to be significantly high at initial visit in case group as compared to controls and showed increasing trend with increasing blood pressure values but the difference among mild and severe PE patients (considering multisystem involvement like HELLP syndrome, AKI, MgSO₄ toxicity, Anemia, Abruptio placenta, Postpartum haemorrhage etc.), failed to achieve the significance, a finding contrary to findings of earlier workers. It may suggest that PDW is a sensitive indicator of hypertension of pregnancy, rising early and is related to high platelet turnover. However, the sensitivity in relation to PE severity needs further exploration with much bigger sample size. Similar results have been observed by Amita et al.

There is a paucity of evidence in literature correlating MPV and PDW with poor fetomaternal outcome. In this study, a significant association of MPV was seen with fetomaternal complications like low APGAR at one minute, low birth weight (21.7%), neonatal ICU admissions (25%), need for blood transfusion (31%), HELLP syndrome (6.7%)

Abruptio placenta (3.4%), Acute Kidney Injury (3.3%) Meshram et al have found similar results.

The study therefore, tends to correlate the pathophysiological changes of PE due to degree of placental changes, with severity (of PE), and/or fetomaternal outcomes with changes in all the platelet indices, clearly ratifying earlier observations that platelet indices can play a significant role in earlier identification of PE and can signal intervention to prevent future complications. MPV among all three indices was found to be more sensitive than others to be linked to severity of PE, and fetomaternal outcome. PDW was not significantly associated with the severity of PE.

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