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ORIGINAL ARTICLE

# Role of Platelet Distribution Width (PDW) and Plateletcrit in the Assessment of Nonthrombocytopenic Preeclampsia and Eclampsia

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## Abstract

*Objective* To evaluate the role of platelet indices in preeclampsia and eclampsia.

*Methods* An observational analytical study was conducted in Department of Obstetrics and Gynaecology, Ambedkar Hospital, Pandit Jawaharlal Nehru Memorial Medical College, Raipur. It was performed on 150 women between March 2015 and February 2016; among them, 42 were taken as controls, 36 were preeclampsia and 72 were eclampsia. Their platelet count and platelet indices were done, analyzed and compared.

*Result* In our study, we found that mean platelet count and mean plateletcrit showed a significant decrease while mean MPV and mean PDW showed a significant increase with increasing severity of disease. Also, we observed that 66.7% preeclampsia and 51.4% eclampsia were non-thrombocytopenic. Among these women, a decrease in the values of plateletcrit and an increase in PDW were seen in a significantly higher number of eclampsia patients. So these two platelet indices can become the new marker for an adverse outcome in preeclampsia and eclampsia even in women presenting with normal platelet counts.

*Conclusion* Platelet indices showed a significant variation along with the severity of the disease. Platelet indices, especially PDW and plateletcrit, can be used along with

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platelet count to evaluate the severity of preeclampsia and eclampsia instead of relying on platelet count alone.

**Keywords** Platelet indices · PDW · Plateletcrit · MPV · PDW · Eclampsia

## Introduction

Pregnancy-induced hypertension is one of the serious complications of pregnancy which affects 5–10% of pregnancies. It presents with hypercoagulable state. A variety of hematological abnormalities may occur in women with PIH of which thrombocytopenia is the most common, which at times may become so severe as to be life threatening [1–3].

Thrombocytopenia in pregnancy-induced hypertensive women may be due to increased adherence of platelets at the site of damaged vascular endothelium leading to increased consumption and secondary destruction of platelets. There is activation of platelets along with increased degranulation leading to decrease in platelet life span and increase in number of immature platelets in peripheral blood smears [1, 4].

Variation in platelet count may be associated with changes in platelet indices, i.e., mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit. MPV and PDW depict the average size and variation in size of platelet, respectively. When thrombocytopenia is due to peripheral platelet destruction, platelet production is stimulated with release of larger platelets in circulation and the mean platelet volume is increased.

The PDW represents the heterogenecity in platelet morphology due to the presence of large platelets along with normal-sized platelets. It can be clinically related to platelet activation. Large platelets are usually more reactive than smaller ones due to the increased number and size of the pseudopodia, leading to increase in the PDW value [5].

Plateletcrit depicts total platelet mass, analogous to the hematocrit for erythrocyte. It has been proposed that hemostatic ability of platelet depends not only on number of platelets but also on size of the platelet because large platelets are functionally more active as compared to small platelets. Plateletcrit being a product of platelet count and MPV reflects changes in both the parameters, i.e., number of platelet and size of platelets. Therefore, plateletcrit or total platelet mass is more indicative of hemostatic capability of platelets than the platelet count alone. However, the circulating blood platelet plays a crucial role in maintaining normal hemostasis. It is the circulating platelet mass, not the platelet count, which is regulated by the body. As plateletcrit is an indicator of platelet activity in blood, low plateletcrit reflects low platelet activity [6–9].

Decrease in platelet count <100,000/L is considered as an indicator of severe disease. A low platelet count is supposed to be a characteristic of worsening of preeclampsia and eclampsia, but several studies have demonstrated that uncontrolled platelet activation and aggregation occur even in nonthrombocytopenic preeclampsia and eclampsia as well [2, 10].

There is a need for evaluation of markers of platelet activation in nonthrombocytopenic cases of preeclampsia and eclampsia as it has been seen that platelet-related parameters are not seriously analyzed in preeclampsia and eclampsia cases having normal platelet count. Evaluation of platelet indices can also help to asses such cases.

Thus, the purpose of this study was to look for new markers of platelet activation, i.e., platelet indices in preeclampsia and eclampsia with a special emphasis on the cases where the platelet counts are normal.

## Materials and Methods

### Participants

The study was performed on 150 pregnant women admitted in Obstetrics Ward of Ambedkar Hospital Raipur, Pt. J.N.M. Medical College, Raipur, between March 2015 and February 2016.

### Inclusion Criteria

This study included 150 women, 42 women as control group. On the basis of blood pressure, urine albumin and convulsions, rest of the pregnant women were categorized into three groups.

Group 1 Normal pregnant women of more than 20 weeks of gestational age.

Group 2 Preeclampsia—patients with BP ≥140/90 mm Hg with urine albumin ≥300 mg/24 h urine.

Group 3 Eclampsia—patients with BP ≥140/90 mm Hg with urine albumin ≥300 mg/24 h urine with convulsions or coma.

### Exclusion Criteria

| | |
|---|---|
| Previous history of— | Hemorrhagic disorder |
| | Epilepsy |
| | Hypertension |
| | Drug intake affecting platelet count |
| | Diabetes mellitus |
| | Renal disease |

Their CBC counts were performed and platelet indices were analyzed in different groups.

From ROC curve analysis, diagnostic cutoff values of above parameters were found.

### Statistical Analysis

Data were analyzed using SPSS for Windows version 17, IBM Corp., NY, and Microsoft Inc., USA. The differences were considered to be statistically significant when the $p$ value obtained was <0.05.

## Results

We found that a maximum number of subjects were of 20–30 years.

Mean age of normal group was 26.3 ± 5.3 years, while mean age of preeclampsia group was 24.3 ± 4.0 years and that of eclampsia group was 24.7 ± 5.2 years.

The groups were found to be age matched ($p < 0.126$). There was no significant age difference between different study groups ($p < 0.126$) (Table 1).

ANOVA and post hoc analysis using Tukey's HSD test indicated that platelet count was significantly lower in preeclampsia and eclampsia compared with normal subjects. Moreover, in eclampsia it was found to be significantly lower compared with preeclampsia subjects. MPV was also significantly higher in preeclampsia and eclampsia compared with normal subjects. PDW was significantly higher in eclampsia compared with normal subjects. Plateletcrit was significantly lower in preeclampsia and eclampsia compared with normal subjects (Table 2).

Though a significant decrease in mean platelet count and mean plateletcrit and a significant increase in mean MPV and mean PDW were seen, incidence of variation of platelet count and platelet indices was different for study groups (Table 3).

Diagnostic cutoff values of various parameters in preeclampsia and eclampsia were obtained using ROC curve analysis (Table 4).

In our study, we found that value of PDW was above normal (9–14 fl) in all the groups; to see the incidence of increased PDW in preeclampsia and eclampsia having normal platelet count, we used the diagnostic cutoff value of PDW 17.45 fl in preeclampsia and 17.25 in fl in eclampsia depicted in Table 3. Incidence of decrease in plateletcrit was also found in both the groups (Table 5).

## Discussion

Uncontrolled platelet activation and aggregation are expected in preeclampsia and eclampsia patients having normal platelet counts [10]. Probably in nonthrombocytopenic pregnancy also in response to platelet activation, there is an increase in bone marrow turnover, leading to production of new and large platelet that leads to maintenance of normal platelet count, but MPV and PDW increase due to large platelets. Increase in MPV can be proportional to degree of thrombocytopenia, so

**Table 1** Comparison of demographic and baseline characteristic in different study groups

| Demographic and baseline characteristics | Normal ($n = 40$) | Preeclampsia ($n = 36$) | Eclampsia ($n = 72$) | $p$ value |
|---|---|---|---|---|
| Age (years) | 26.3 ± 5.3 | 24.3 ± 4.0 | 24.7 ± 5.2 | 0.126 |
| Incidence of primigravida (%) | 35% | 47.2% | 59.7% | |
| Systolic BP (mm Hg) | 120.5 ± 7.1 | 151.9 ± 14.8 | 157.6 ± 15.8 | <0.0001 |
| Diastolic BP (mm Hg) | 79.7 ± 6.2 | 98.3 ± 9.7 | 102 ± 11.7 | <0.0001 |

**Table 2** Comparison of mean values of different parameters in different study groups

| Parameters | Groups | | | |
|---|---|---|---|---|
| | Normal ($n = 40$) | Preeclampsia ($n = 36$) | Eclampsia ($n = 72$) | $p$ value |
| Platelet count ($10^3$/cu. mm) | 280.0 ± 89.8 | 196.2 ± 88.7[a] | 147.8 ± 53.3[a,b] | <0.0001 |
| MPV (fl) | 8.1 ± 1.1 | 9.0 ± 0.9[a] | 9.5 ± 1.3[a,] | <0.0001 |
| PDW(fl) | 16.5 ± 0.86 | 16.9 ± 1.09 | 17.4 ± 1.03[a] | <0.0001 |
| Plateletcrit | 0.22 ± 0.06 | 0.17 ± 0.07[a] | 0.14 ± 0.05[a] | <0.0001 |

[a] $p < 0.05$ versus normal

[b] $p < 0.05$ versus preeclampsia

**Table 3** Comparison of incidence of change in platelet count and platelet indices in different study groups

| Parameters | Preeclampsia $n = 36$ | | | | Eclampsia $n = 72$ | | | |
|---|---|---|---|---|---|---|---|---|
| Platelet count | Normal | | Decreased | | Normal | | Decreased | |
| | No | % | No | % | No | % | No | % |
| | 24 | 66.7 | 12 | 33.3 | 37 | 51.4 | 35 | 48.6 |
| MPV | Normal | | Increased | | Normal | | Increased | |
| | No | % | No | % | No | % | No | % |
| | 36 | 100 | 00 | 00 | 72 | 100 | 00 | 00 |
| PDW | Normal | | Increased | | Normal | | Increased | |
| | No | % | No | % | No | % | No | % |
| | 00 | 00 | 36 | 100 | 00 | 00 | 72 | 100 |
| Plateletcrit | Normal | | Decreased | | Normal | | Decreased | |
| | No | % | No | % | No | % | No | % |
| | 13 | 36.1 | 23 | 63.9 | 13 | 18.1 | 59 | 81.9 |

**Table 4** Diagnostic cutoff values of various parameters for various ailments

| Groups | Parameter | Sensitivity (%) | Specificity (%) | Cutoff |
|---|---|---|---|---|
| Preeclampsia | Platelet count ($10^3$/cu mm) | 65 | 78 | 179.5 |
| | MPV (fl) | 65 | 75 | 8.85 |
| | PDW (fl) | 46 | 80 | 17.45 |
| | Plateletcrit | 5 | 83 | 0.14 |
| Eclampsia | Platelet count ($10^3$/cu.mm) | 88 | 57 | 212.5 |
| | MPV (fl) | 62 | 75 | 9.15 |
| | PDW (fl) | 64 | 68 | 17.25 |
| | Plateletcrit | 75 | 58 | 0.18 |

**Table 5** Comparison of incidence of change in PDW and plateletcrit in preeclampsia and eclampsia

| Groups | Parameter | | $p$ value |
|---|---|---|---|
| | ↑ PDW (%) | ↓ PDW (%) | |
| Nonthrombocytopenic eclampsia ($n = 38$) | 57.9 | 42.1 | 0.0006 |
| Nonthrombocytopenic reeclampsia ($n = 24$) | 33.3 | 66.7 | |
| | ↓ Plateletcrit (%) | Normal plateletcrit (%) | |
| Nonthrombocytopenic eclampsia ($n = 38$) | 63.2 | 36.8 | <0.0001 |
| Nonthrombocytopenic preeclampsia ($n = 24$) | 25 | 75 | |

normal value of MPV can be seen. Plateletcrit also reflects changes in MPV and platelet count.

In our study, the mean platelet count showed a significant decrease, but the values were within normal range 66.7 and 51.4% of preeclampsia and eclampsia women, respectively, showing normal platelet counts.

Many studies found similar results showing a significant decrease, but the values were within normal range [1, 3, 11, 14].

Mean MPV also showed a significant increase with increasing severity of PIH though the values were within normal range; moreover, on the lower side of normal range (normal value of MPV) various studies also found similar results [10, 14–18]. Low normal-sized platelets in our study can be attributed to normal or near normal platelet count, as platelet size is directly related to degree of thrombocytopenia. The number of large platelets, though being formed by bone marrow compensation, is not enough in comparison with small platelet to indicate an increase in MPV.

Mean PDW was found to show a significant increase and its value was above normal range in all the groups including controls. Similar observations were seen in other studies also [10, 12, 13, 15, 16, 18]. PDW reflects anisocytosis (difference

in size) of platelets, which may occur due to increased production of platelets in bone marrow resulting in large platelets. Uncontrolled platelet activation and aggregation are expected in nonthrombocytopenic pregnancies as well [14]. It can lead to increased platelet consumption though compensated by bone marrow. Increased PDW reflecting increased bone marrow turnover even in group having normal platelet count suggests platelet activation and aggregation in nonthrombocytopenic condition in pregnancy as well. Probably, this is the reason of increased PDW even in normal controls as pregnancy itself is a hypercoagulable state.

Increase in mean PDW can be directly linked with degree of thrombocytopenia in our study, supported by other studies as well. Above facts make PDW a very important parameter in assessment of pregnancy-induced hypertension as a reflection of ongoing platelet activation even in nonthrombocytopenic conditions. Serial estimation of mean PDW can be of a great help in understanding the severity of the disease.

Significant decrease in mean plateletcrit was seen in preeclampsia and eclampsia. The mean values were below normal in both the groups. Moreover, decrease was seen in 63.9% patients of preeclampsia and 81.9% patients of eclampsia making this parameter very important for assessing the severity of plateletcrit. A number of studies also showed similar results [10, 18]. Decrease in mean plateletcrit can be attributed to low normal values of platelet size/MPV in our study. As compared to platelet count, MPV and PDW, less work has been done on plateletcrit. Plateletcrit is a measure of total platelet mass. Being a product of platelet count and MPV, it can reflect changes in both the parameters. Further studies are going on to see whether plateletcrit can be used instead of platelet counts alone as a screening tool for detection of platelet quantitative disorders.

In eclampsia patients having normal platelet count, in higher number of patients plateletcrit was decreased (63.2%), while PDW was increased (57.9%), strengthening our view that for assessing the severity of this condition we cannot rely on platelet count alone.

## Conclusion

We found a significant relationship between platelet indices and severity of PIH, i.e., increase in MPV and PDW and decrease in plateletcrit along with an increase in severity of PIH. Platelet indices estimation, especially PDW and plateletcrit, should be assessed to evaluate the severity of preeclampsia and eclampsia along with platelet count, instead of relying on platelet count alone, as normal platelet count does not rule out a severe disease.

Serial detection of the PDW and plateletcrit throughout pregnancy can be used to asses the severity of the condition. Furthermore, changes in these parameters can help in deciding the timing of delivery for women with PIH, especially in women in the gray zone.

**Compliance with Ethical Standards**

**Conflict of interest** Abha Singh and Ruchi Varma declare that they have no conflict of interest.

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