

A Study of Variation in Platelet Parameters in Pregnancy

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ABSTRACT

Introduction: With improvement in technologies, automated cell counters are widely used for analysing platelet abnormalities in various clinical conditions using platelet parameters. Among them platelet counts, mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), and platelet large cell ratio (P-LCR) are important parameters. This research was aimed to study platelet parameters and their variations in pregnancy.

Methodology: A prospective study was carried out from March to September 2017. Data from 400 patients were analyzed using Microsoft Excel and SPSS version 20.

Results: A total 400 patients were studied. Pregnant females showed decreasing platelet count from first trimester to third trimester whereas MPV, PDW, and P-LCR increased from first trimester to third trimester. Pearson correlation showed that PDW, MPV, and P-LCR were inversely related with platelet count in pregnancy state, whereas plateletcrit was directly related with platelet count and PDW, MPV, and P-LCR were directly proportional to one another.

Conclusion: Platelet count decreases with pregnancy from first trimester to third trimester. Low platelet count and high MPV can be used as indicators of preeclampsia.

INTRODUCTION

Platelets are anucleate, disc shaped, cytoplasmic fragments of megakaryocytes which are involved in hemostasis, tissue repairing, and infections. They are active participants in the host defences through phagocytosis and generation of cytotoxic free radicals and oxidative molecules, when activated. Determinations of platelet size are traditionally made by microscopic measurements of platelet diameters, a method which is not readily available in routine daily practice.^{1,2} With the availability of automated blood cell analyzers, new

indices related to platelet count are being estimated. Most important parameters among them are total platelet count (TPC), plateletcrit (PCT), mean platelet volume (MPV), platelet distribution width (PDW), and platelet large cell ratio (P-LCR).³

Pregnancy is associated with endothelial stress and increased platelet aggregation in the uteroplacental circulation resulting in a progressive fall in platelet count with increasing gestational age. Also, the increase in plasma volume associated with pregnancy results in a dilutional thrombocytopenia.⁴ Elevated platelet aggregation in pregnancy has been attributed to increased formation of thromboxane A₂, more intracellular calcium mobilisation, and reduced synthesis of cyclic AMP. Some studies have also reported increased plasma levels of β -thromboglobulin and GP53 (CD63), a marker of lysosomal membrane in the third trimester.^{5,6} As the bone marrow compensates for the rapid consumption of platelets by releasing younger and larger platelets, the mean platelet volume (MPV) which is an index of the average platelet size tend to increase.^{7,8} An inverse relationship between platelet count (PLT) and MPV was reported as in non-pregnant women.⁹ The platelet distribution width (PDW), a measure of platelet anisocytosis, was also reported to increase in the course of normal pregnancy.^{10,11} PDW increase while plateletcrit (PCT) which is a measure of the relative volume of platelets in a given volume of whole blood, decrease throughout pregnancy.¹²

Preeclampsia is a part of clinical syndrome characterized by increase in blood pressure and proteinuria occurring after 20 weeks of gestation. It is a major cause of morbidity and mortality among mother and fetus. If untreated, it may progress to eclampsia and eventually prove fatal.¹³ Preeclampsia is usually asymptomatic and treatment being not standardized, prevention by early diagnosis holds implications, which requires an easy and

cost-effective test.

Platelet parameters have been found to have a predictive value in the evolution of preeclampsia. An increase in MPV has been noted about two weeks before the increase in blood pressure and other clinical features of preeclampsia development.¹⁴ Some studies reported lower platelet counts and higher PDW, MPV, and platelet-large cell ratio (P-LCR) in patients with preeclampsia and eclampsia compared to normal pregnant women.¹⁵ Thus, platelet count and platelet indices can be of diagnostic and prognostic significance in preeclampsia and eclampsia. This study aimed to evaluate the various platelet parameters and their variation in pregnancy and associated medical conditions in Ajmer region.

METHODS

It was an observational cross sectional study undertaken over a period of six months from March 2017 to September 2017. Pregnant females presenting to both indoor and outdoor departments were included in the study. A total of 400 cases were analyzed. Patients on antiplatelet therapy, with history of recent blood transfusion, haemolysed among blood sample, and blood samples of non-pregnant subjects were excluded from the study. Venous blood sample was collected aseptically by standard phlebotomy technique from each subject into tri-potassium ethylenediamine tetra-acetic acid (K3EDTA) anticoagulant containing vial. The sample were analysed by Sysmex automated hematology analyser SYSMEX XS-800i, 5 part differential haematology analyser.

Patient information regarding age, sex, clinical history, and all platelet parameters were recorded from each case. Patients were further classified on the basis of associated medical conditions like diabetes, hypothyroidism, high blood pressure (BP), and preeclampsia. Criteria for preeclampsia included:

1. Systolic blood pressure greater than 140 mmHg, diastolic blood pressure (DBP) greater than 90 mmHg on two measurements taken 6 hours apart or on one measurement >150/110 mm Hg, and
2. Proteinuria more than 300 mg in 24 hours urine.

The preeclampsia (PE) group was further divided into three categories as:

1. Mild preeclampsia- Diastolic BP between 90 and 100 mm Hg
2. Moderate preeclampsia- Diastolic BP between 100

and 110 mm Hg

3. Severe preeclampsia- BP>160/110 mmHg, oliguria (<400 ml in 24 hours urine), headache, blurred vision, right epigastric- right upper quadrant pain, pulmonary edema, and cyanosis, >5 grade proteinuria in 24 hours urine or > +++ proteinuria in spot urine sample, abnormal liver function tests.

Data were entered and analysed with Microsoft Excel as well as SPSS version 20. The qualitative variables were analysed as percentages. For quantitative variables, mean and standard deviation (SD) were used. For detecting correlation between two quantitative variables, Pearson correlation test was used. Detection of difference was done by one-way ANOVA test. $p < 0.05$ indicated statistically significant differences.

RESULTS

Out of 400 pregnant females, 73.75% (n=295) females presented in third trimester of pregnancy, 14.5% (n = 58) in second trimester and 11.75% (n = 47) in first trimester (Figure 1). On analysing pregnant females without any associated medical condition platelet count was highest among first trimester females followed by second trimester and then third trimester females. Whereas MPV, PDW, and P-LCR showed the reverse trend. However, PCT was highest among second trimester females (Figure 1).

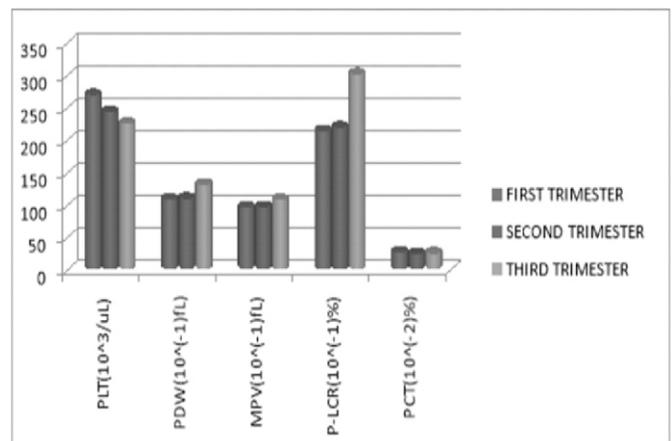


Figure 1: Variations in platelet parameters in pregnancy without associated medical conditions.

It was observed that pregnancy associated with medical conditions showed variation in platelet parameters. 14 females presented with thyroid disorder along with pregnancy, 19 with diabetes, 26 with raised blood

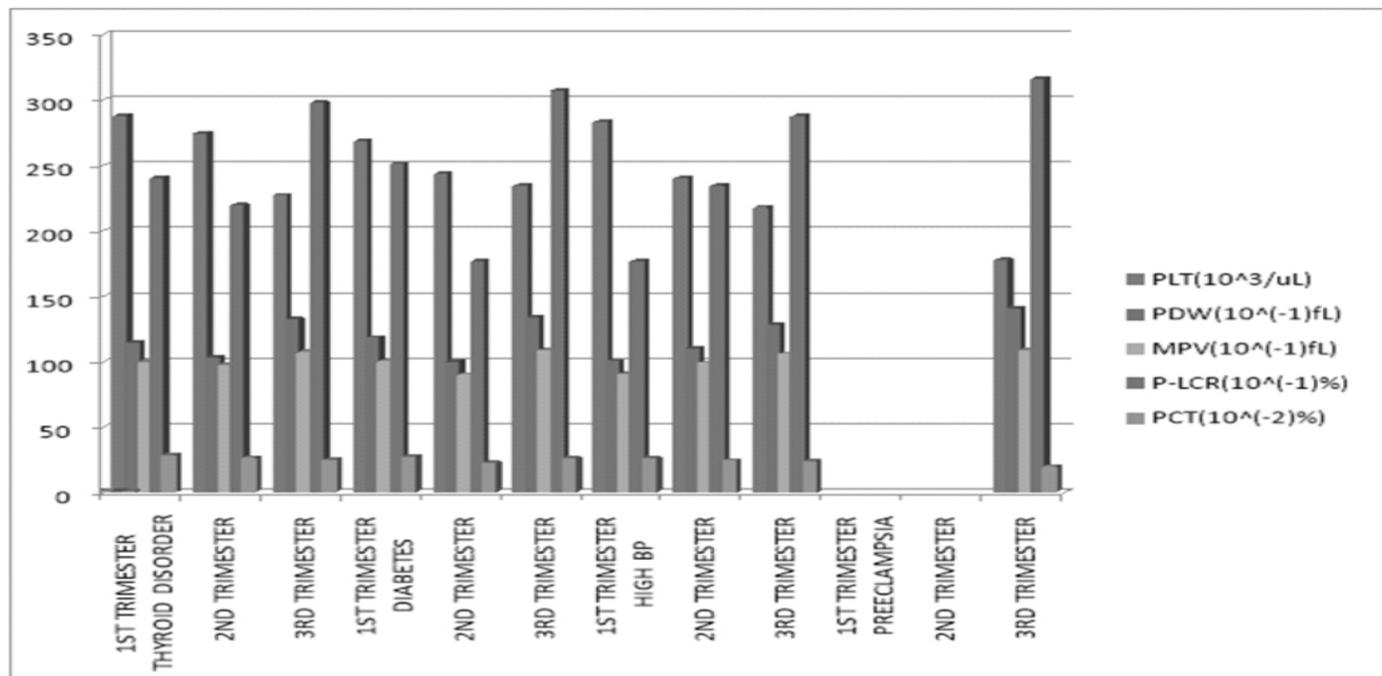


Figure 2: Variations in platelet parameters in pregnancy associated with medical conditions.

Table 1: Platelet parameters in preeclamptic patients

| | Mild preeclampsia N=7 (Mean ± SD) | Moderate preeclampsia N=13 (Mean ± SD) | Severe preeclampsia N=6 (Mean ± SD) |
|----------------------------|---|--|---|
| PLT (10 ³ µl) | 194.2 ± 8.4 | 173.1 ± 2.9 | 163.6 ± 8.3 |
| PDW (10 ⁻¹ fL) | 130.1 ± 36.1 | 132.5 ± 17 | 167.8 ± 32.4 |
| MPV (10 ⁻¹ fL) | 105.5 ± 14.9 | 107.2 ± 6 | 114 ± 12.6 |
| P-LCR (10 ⁻¹ %) | 289.8 ± 111 | 307.5 ± 47 | 361.16 ± 79 |
| PCT (10 ⁻² %) | 20.4 ± 3.5 | 18.6 ± 1.1 | 18.6 ± 2.5 |

pressure, and 26 cases presented with preeclampsia. Pregnant females with preeclampsia showed lower platelet count (176.65±12.998) and higher values of MPV, PDW, and P-LCR and low levels of PCT. Females in first trimester of pregnancy with thyroid disorder had comparatively higher platelet count and PCT values whereas low levels of PDW and P-LCR and high MPV values were observed in diabetic females in second trimester of pregnancy (Figure 2).

Based on the criteria described above, out of 26 cases in preeclampsia group; 7 (26.9%) were mildly preeclamptic, 13 (50%) were moderately preeclamptic, and 6 (23.07%) were severely preeclamptic. It was observed that platelet count showed decreasing trend from mild to severe preeclampsia whereas MPV increased from mild to severe preeclampsia (Table 1).

Upon correlating platelet count with other platelet parameters using Pearson correlation, it was observed that PDW, MPV, and P-LCR were inversely related with platelet count in pregnancy state but this association was not significant. Whereas plateletcrit was directly related with platelet count and there was a strong association between the two. p value was significant in all the above parameters indicating that there was significant difference amongst them statistically (Table 2).

There was significant direct association between PDW, MPV, and P-LCR in pregnancy. They were directly proportional to one another and p value was statistically significant indicating that there was a significant difference in between these parameters in pregnancy (Table 3).

Table 2: Correlation between platelet count and platelet parameters in various pregnancy states

| | Platelet Count | | | |
|----------------------------|----------------|----------|----------|---------|
| | PDW | MPV | P-LCR | PCT |
| Pearson correlation | -0.312** | -0.303** | -0.315** | 0.951** |
| p value | 0.000 | 0.000 | 0.000 | 0.000 |

Table 3: Correlation between MPV, PDW, and P-LCR in various pregnancy states

| | PDW and MPV | MPV and P-LCR | PLCR and PDW |
|----------------------------|-------------|---------------|--------------|
| Pearson correlation | 0.943** | 0.993** | 0.957** |
| p value | 0.000 | 0.000 | 0.000 |

DISCUSSION

This study found out that platelet count decreased from first trimester to third trimester in normotensive pregnant females. PDW, MPV, and P-LCR were inversely related with platelet count in pregnancy state. There was statistically significant direct association between PDW, MPV, and P-LCR in pregnancy as they were directly proportional to one another. Significant decrease in platelet count in patients with preeclampsia was observed.

Dadhich S et al¹³ had found that patients with preeclampsia are more likely to have rapid and significant decrease in platelet count and increase in PDW and MPV in comparison to normotensive counterparts. These significant changes can be observed at an earlier gestational age than significant rise in BP can be observed and changes are more significant in patients who are destined to develop progressive severe hypertension. Changes in these three parameters can be correlated with changes in BP and hence prediction of patients likely to develop progressive hypertension can be done earlier and intervention done accordingly. Thus, estimation of platelet indices seems to be a reliable rapid, easy, and economical method for early detection of preeclampsia and assessment of its severity.

Amita K et al¹⁶ observed that the platelet count significantly decreased in preeclampsia patients as compared to normal pregnant controls. In their study, there was no significant increase in MPV with increasing severity of preeclampsia; however, PDW was significantly higher in preeclampsia group than in normal control group. The reason for increased PDW is explained by increased platelet turnover which would support the idea that platelet survival time is decreased resulting in increased destruction of platelets. This may be also because of

increased bone marrow activity of unknown stimulus. Bhavana T et al¹⁷ studied platelet indices in pre-gnancy induced hypertension and observed that the platelet count has an association at prediction of increasing grade of PIH. There is an inverse relationship between the severity of PIH and platelet count. The depleted platelet counts are concluded to be consistently associated with clinical groups of severe preeclampsia and eclampsia and the risk of consumptive coagulopathy. The platelet indices of MPV and PDW too are in consistent relationship with PIH. Their greater values suggest increase grade of PIH and its severity i.e. pre-eclampsia, severe preeclampsia, eclampsia, and the risk of consumptive coagulopathy. There is definite statistical difference in values of platelet count and platelet indices in PIH groups when compared with normotensive pregnant women. As PIH is known to land in consumptive coagulopathy, their study concluded that the estimation of platelet count and platelet indices offer an early, simple and rapid assessment of the disease for its severity and the risk of complications. Therefore, these tests may be considered as screening tests to be routinely performed in antenatal workup of women with PIH.

AlSheeha MA et al¹⁸ demonstrated significantly lower platelet count and platelet count to MPV ratio in patients with preeclampsia compared with the normal controls but failed to show similar trend when MPV and PDW were evaluated in the same study groups. Aakriti Gupta et al¹⁹ studied that there was significant decrease in platelet count in preeclampsia and eclampsia patients when compared to control group i.e. normotensive pregnant patients in their third trimester of pregnancy. In their study, they observed that as the severity of PIH increases from mild preeclampsia to severe preeclampsia and eclampsia, a decreasing trend of platelet count is seen and

the association is statistically significant. They observed that cases with low platelet counts had increased risk of maternal and fetal complications. Most of the PIH cases who developed preterm labour, impending eclampsia, and placental abruption had platelet count in the range of 1.0 to 1.5 lakh/mm³. Out of five PIH cases who presented with thrombocytopenia, two women had pulmonary edema, one had placental abruption, one had DIC, and one maternal death occurred. Most of the fetal complications were also seen in cases with platelet count in the range of 1.0 to 1.5 lakh/mm³. In all of the 5 women who developed thrombocytopenia, intrauterine fetal demise was seen.

CONCLUSION

The present study showed that in general platelet count decreases with pregnancy from first trimester to third trimester. This decrease is significant in cases of pre-eclampsia. Low platelet count and high MPV can be used as indicator and prognostic marker of preeclampsia.

REFERENCES

1. Henning BF, Zidek W, Linder B, Tepel M. Mean platelet volume and coronary heart disease in hemodialysis patients. *Kidney Blood Press Res.* 2002;25(2):103-08.
2. Kaito K, Otsubo H, Usui N, Yoshida M, Tanno J, Kurihara E et al. Platelet size deviation width, platelet large cell ratio, and mean platelet volume have sufficient sensitivity and specificity in the diagnosis of immune thrombocytopenia. *Br J Haematol.* 2005;128(5):698-702.
3. Wiwanitkit V. Plateletcrit, mean platelet volume, platelet distribution width: Its expected values and correlation with parallel red blood cell parameters. *Clin Appl Thromb Hemost.* 2004;10(2):175-78.
4. M Valera, O Parant, C Vayssiere, JO Arnal JO, B Payrastre. Physiologic and pathologic changes of platelets in pregnancy. *Platelets.* 2010;21(8):587-95.
5. Ghoshal K, Bhattacharyya M. Overview of platelet physiology: Its hemostatic and nonhemostatic role in disease pathogenesis. *The Scientific World Journal.* 2014;781-857.
6. J Piazze, S Giola, A Spagnuolo, A Cerekja. Platelets in pregnancy. *Journal of Prenatal Medicine.* 2011;5(4):90-92.
7. JR Sheu, G Hsiao, MY Shen, WY Lin, CR Tzeng. The hyperaggregability of platelets from normal pregnancy is mediated through thromboxane A2 and cyclic AMP pathways. *Clin Laboratory Haematol.* 2002;24:121-29.
8. RA Fay, AO Hughes, NT Farron. Platelets in pregnancy: Hyperdestruction in pregnancy. *Obstet Gynecol.* 1983;61:238-40.
9. Y Ahmed, B van Iddekinge, C Paul, MHF Sullivan, MG Elder. Retrospective analysis of platelet numbers and volumes in normal pregnancy and preeclampsia. *Br J Obstet Gynaecol.* 1993;100:216-20.
10. PR Sill, T Lind, W Walker. Platelet value during normal pregnancy. *Br J Obstet Gynaecol.* 1985;92(5):480-83.
11. SG Tygart, DK McRoyan, JA Spinnato, CJ McRoyan, DZ Kitay. Longitudinal study of platelet indices during normal pregnancy. *Am J Obstet Gynecol.* 1986;154(4):883-87.
12. PE Marcelina-Roumans, JM Ubachs, JW van Wersch. Platelet count and platelet indices at various stages of normal pregnancy in smoking and non-smoking women. *Eur J Clin Chem Biochem.* 1995;33(5):267-69.
13. Dadhich SR, Agarwal S, Soni M, Choudhary R, Jain R, Sharma S et al. Predictive value of platelet indices in development of preeclampsia. *Journal of South Asian Federation of Obstetrics and Gynaecology.* 2012;4(1):17-21.
14. R Hutt, SO Oguniyi, MH Sullivan M, MG Elder. Increased platelet volume and aggregation precede the onset of pre-eclampsia. *Obstet Gynecol.* 1994;83:146-49.
15. A Vamseedhar, K Srinivasa, SY Santhosh, DR Suresh. Evaluation of platelet indices and platelet counts and their significance in pre-eclampsia and eclampsia. *Int J Biol Med Res.* 2011;2(1):425-28.
16. Amita K, Nithin Kumar H, Shobha SN, Vijay Shankar. The role of platelet parameters as a biomarker in the diagnosis and in predicting the severity of preeclampsia. *Indian Journal of Pathology and Oncology.* 2015;2(2):57-60.
17. Thakur Bhavana, Kulkarni Vishal, Thakur Prashant. Platelet indices in pregnancy induced hypertension. *J Cont Med A Dent.* 2016;4(3):20-26.
18. Muneera A AlSheeha, Rafi S Alaboudi, Mohammad A Alghasham, Javed Iqbal, Ishag Adam. Platelet count and platelet indices in women with preeclampsia. *Vascular Health and Risk Management.* 2016;12:477-80.
19. Gupta A, Hak J, Sunil I, Gupta A. Platelet count estimation: A prognostic index in pregnancy induced hypertension. *Int J Reprod Contracept Obstet Gynecol.* 2018;7:476-82.

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