International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Saini N et al. Int J Reprod Contracept Obstet Gynecol. 2022 Nov;11(11):3053-3061
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20222795

Original Research Article

Utility of platelet count and platelet indices as a prognostic indicator in pregnancy induced hypertension

Neha Saini*, Roli Gautam, Shanti Jeyaseelan

Department of Obstetrics and Gynecology, Holy Family Hospital, New Delhi, India

Received: 28 August 2022
Revised: 29 September 2022
Accepted: 30 September 2022

***Correspondence:**
Dr. Neha Saini,
E-mail: dr.nehasaini07@gmail.com

ABSTRACT

Background: Changes in the hemostatic system are observed in both normal and hypertensive pregnant patients. Although the exact pathophysiology of pregnancy induced hypertension is not completely understood, numerous pathophysiological mechanisms, alone or in combination, have been suggested to be responsible for the diverse subsets of PIH.
Methods: This was a prospective case control study conducted on 100 pregnant females (50 PIH and 50 normotensive) at Holy Family Hospital, New Delhi, from October 2020 to May 2021. platelet count and platelet indices (mean platelet volume and ratio of platelet count to mean platelet volume) at 32 weeks and at time of delivery were checked and Outcomes were compared.
Results: For predicting PIH, platelet count showed sensitivity of 82% and specificity of 54%, MPV sensitivity of 54% and specificity of 82%, PC/MPV sensitivity of 82% and specificity of 62%. For predicting pre-eclampsia without severe symptoms, platelet count showed sensitivity of 89.47% and specificity of 47.62%, mean platelet volume sensitivity of 47.37% and specificity of 76.19%, platelet count/mean platelet volume sensitivity of 31.58% and specificity of 100%. We also found that in predicting pre-eclampsia with severe symptoms platelet count showed a sensitivity of 100% and specificity of 26.32%, whereas, mean platelet volume showed equal sensitivity and specificity of 55.56%, platelet count/mean platelet volume with sensitivity of 44.44% and specificity of 84.21%.
Conclusions: We found that platelet count and platelet count/mean platelet volume decreases while mean platelet volume increases with severity of pregnancy induced hypertension.

Keywords: Platelet count, Platelet indices, Pregnancy induced hypertension

INTRODUCTION

Hypertension is a common clinical complication during pregnancy.[1] The most widely used term at present for hypertensive disorder in pregnancy is Pregnancy induced hypertension (PIH). It affects approximately 6-8 % of all pregnancies, most often the primigravida.[1] About 18% of foetal deaths are associated with hypertensive disorders.[1]

Changes in the hemostatic system are observed in both normal and hypertensive patients.[2] Although the exact pathophysiology of PIH is not completely understood, Numerous pathophysiological mechanisms, alone or in combination, have been suggested to be responsible for the diverse subsets of PIH. They include impaired vascular remodelling of the maternal-fetal interface, excessive immune response to paternal antigens, systemic inflammatory response, and dysfunctional placental or endothelial response, all of these processes being modulated by genetic and environmental parameters.[3] Thus, in series it includes deficient trophoblastic invasion of the maternal vascular bed with subsequent reduction of placental blood flow. Placental perfusion initiates widespread systemic, maternal endothelial dysfunction,

and increased vascular permeability. Coagulation system is activated by the contact of platelets with the injured endothelium leading to increase in consumption as well as bone marrow production of platelets.[4] The fall in the platelet count (PC) is the most frequent abnormality and is probably due to consumption during low grade intravascular coagulation.[3]

Though PC during pregnancy is within the normal non pregnant reference values, there is a tendency for the PC to fall in late pregnancy. In the third trimester the change in the PC is due to haemodilution, increased platelet consumption and increased platelet aggregation leading to increased levels of TXA_2. Severe thrombocytopenia, less than 50,000/ml is seen in 0.1% pregnancies only. The frequency and intensity of maternal thrombocytopenia varies and is dependent on the intensity of the disease process and duration of PIH syndrome. In general, the lower the PC, the higher the maternal and fetal morbidity and mortality.[2]

Various indices are also used to measure platelet functions, for example, the platelet count (PC), mean platelet volume (MPV), the PC to MPV ratio (PC/MPC), and platelet distribution width (PDW).[4] Platelet indices are potentially useful markers for the early diagnosis of thromboembolic diseases. As there is increase in both mean platelet volume (MPV) and platelet distribution width (PDW) due to platelet activation i.e. if an activating stimulus (exposed collagen and von Willebrand factor i.e. injured endothelium) is sufficient (threshold level) platelet activation occurs. This is associated with granule secretion (the release reaction) and stimulation of prostaglandin synthesis. Granule contents are released through a canalicular system that connects the interior of the platelet with the external environment. Prostaglandin synthesis is initiated. When phospholipase A_2 generates arachidonic acid from platelet phospholipids arachidonic acid subsequently is converted by platelet cyclooxygenase to labile endoperoxides (PGG_2, PGH_2) that they are converted by thromboxane synthase to TX A_2, a potent activator and vasoconstrictor.[5] Platelet activation also leads to expression of the GP IIb- IIIa receptor fibrinogen binding and platelet aggregation, leading to increased consumption of platelets and increased bone marrow production.[5] As a result, bone marrow releases young platelets which are larger in size resulting in increased platelet indices MPV and PDW.[6]

The current study was conducted to evaluate platelet count and platelet indices (MPV and PC/MPV) in women with PIH patients and comparing it with normotensive patients.

METHODS

The present study was a prospective case control study conducted on 100 pregnant females attending antenatal OPD at Holy Family Hospital, New Delhi, from October 2020 to May 2021. The case and control were selected randomly after 32 weeks of gestational age irrespective of parity. Patients were recruited in the study after informed consent obtained from them and they had participated in the study on a voluntary basis. All patients in the study were subjected to detailed history which includes history of present pregnancy, obstetric history, menstrual history, past history, family history. POG was estimated by calculation from the first day of LMP and by early ultrasound examination.

The optimal measurement of blood pressure (BP) was made with the patient comfortably seated, legs uncrossed, and the back and arm supported, so that the middle of the cuff on the upper arm was at the level of the right atrium (the midpoint of the sternum). The patient was instructed to relax and not talk during the measurement procedure; ideally 5 minutes should elapse before the first reading is taken. If elevated on initial assessment, the BP measurement was repeated after several minutes to attempt to eliminate spuriously elevated BP determinations.

According to ACOG, PIH can be defined as blood pressure greater than or equal to 140 mmHg systolic or greater than or equal to 90 mmHg diastolic on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with a previously normal blood pressure. Preeclampsia with mild features is considered when pregnancy induced hypertension is associated with proteinuria greater than or equal to 300 mg per 24-hour urine collection or Protein/creatinine ratio greater than or equal to 0.3*, Dipstick reading of 1+ (used only if other quantitative methods are not available).

Preeclampsia with severe features can be defined as systolic blood pressure greater than or equal to 160 mmHg or diastolic greater than or equal to 110 mmHg associated with proteinuria or in the absence of proteinuria, new-onset hypertension with the new onset of any them thrombocytopenia (PC<100,000/microliter), renal insufficiency (serum creatinine concentrations >1.1 mg/dl), impaired liver function, pulmonary edema, cerebral or visual symptoms.[7]

PC and platelet indices (MPV and PC/ MPV) estimation was done at time of enrolment for study i.e. after 32 weeks and during delivery. Under aseptic conditions, the sample (2 ml) was collected in ethylene diamine tetra acetic acid (EDTA) vials. The samples were analysed on the Automated Beckmann Counter LH-750 on which was observe the platelet indices, which include PC, MPV. 50 patients with PIH were selected as cases and 50 normotensive patients were taken as controls. All women received regular antenatal care and were followed up until delivery. Collected data was analysed with appropriate statistical tests for final inference.

Statistical analysis

The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means±SD as

median with 25th and 75th percentiles (interquartile range). The following statistical tests were applied for the results: 1) the comparison of the variables which were quantitative in nature were analysed using independent t test (for two groups) and ANOVA test (for more than two groups), 2) the comparison of the variables which were qualitative in nature were analysed using the Chi-Square test. If any cell had an expected value of less than 5 then Fisher's exact test was used, 3) receiver operating characteristic curve was used to find cut off of platelet indices for predicting PIH.

The data entry was done in the Microsoft Excel spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, version 21.0.

For statistical significance, p value of less than 0.05 was considered statistically significant.

RESULTS

In the study distribution of age (years), body mass index (kg/m²) and parity were comparable between cases and controls. Maximum number of patients were in age group of 26-30 years in both case and control with no significant difference.

Table 1 shows statistically significant decrease in PC and PC/MPV between third trimester and delivery in cases in compare to control group, whereas statistically significant increase in MPV was seen in cases.

Table 1: Association of percentage change in platelet indices between third trimester and at delivery in cases and controls.

Percentage change in platelet indices	Cases (n=50)	Controls (n=50)	Total	P value
Percentage decrease in platelet count				
Mean±SD	27.27±15.48	9.41±12.18	18.34±16.51	
Median (25th-75th percentile)	26.22 (18.603-37.425)	6.31 (3.673-15.062)	15.89 (5.618-29.181)	<0.0001*
Range	-12.2-60	-19.05-66.32	-19.05-66.32	
Percentage increase in MPV				
Mean±SD	10.47±7.34	7.09±6.67	8.78±7.18	
Median (25th-75th percentile)	8.86 (6.256-13.651)	6.21 (3.061-8.736)	7.5 (3.896-11.88)	0.018*
Range	-6.87-40	-4-29.91	-6.87-40	
Percentage decrease in Platelet count/mean platelet volume				
Mean±SD	34.18±15.38	15.04±13.51	24.61±17.32	
Median (25th-75th percentile)	34 (23.812-45.347)	12.9 (8.86-20.024)	21.29 (12.372-35.376)	<0.0001*
Range	-0.21-64.4	-23.99-73.93	-23.99-73.93	

*Independent t test

Table 2: Association of platelet indices between third trimester and severity of PIH.

Platelet indices (>32 weeks)	Gestational HTN (n=21)	Pre eclampsia without severe symptoms (n=19)	Pre eclampsia with severe symptoms (n=9)	Eclampsia (n=1)	Total	P value
Platelet count (×10³/µl)						
Mean±SD	236.1±38.45	204.47±38.4	191±24.86	168±0	214.6±40.38	
Median (25th-75th percentile)	234 (209-263)	201 (183-225)	196 (170-209)	168 (168-168)	209.5 (196.5-235.75)	0.006§
Range	162-302	118-284	155-224	168-168	118-302	
Mean platelet volume (fl)						
Mean±SD	10.3±1.13	10.14±1.23	10.79±1.6	12.7±0	10.37±1.29	
Median (25th-75th percentile)	10.4 (9.9-10.8)	10 (9.1-11.15)	11.1 (9.2-12.1)	12.7 (12.7-12.7)	10.15 (9.2-11.175)	0.179§
Range	8.4-13.1	8.2-12.3	8.5-12.8	12.7-12.7	8.2-13.1	
Platelet count/mean platelet volume						
Mean±SD	23.22±5.11	20.41±4.24	18.96±5.64	13.22±0	21.19±5.17	
Median (25th-75th percentile)	21.4 (19.5-24.8)	21 (16.98-24.4)	17.35 (14.05-22.1)	13.22 (13.22-13.22)	21.05 (17.925-24.4)	0.046§
Range	17.8-34.5	10.3-26.1	13.13-30.5	13.22-13.22	10.3-34.5	

§ANOVA

Table 3: Association of platelet indices at delivery between severity of PIH.

Platelet indices at delivery	Gestational HTN (n=21)	Pre eclampsia without severe symptoms (n=19)	Pre eclampsia with severe symptoms (n=9)	Eclampsia (n=1)	Total	P value
Platelet count (×10³/µl)						
Mean±SD	182.81±40.66	143.74±42.8	133.11±33.45	82±0	157±45.86	0.002§
Median (25th-75th percentile)	180 (153-208)	146 (119-173)	132 (124-154)	82 (82-82)	153.5 (127.25-189.5)	
Range	109-256	62-223	83-188	82-82	62-256	
Mean platelet volume (fl)						
Mean±SD	11.1±1	11.12±1.3	12.49±1.5	14.8±0	11.43±1.38	0.002§
Median (25th-75th percentile)	11.2 (10.5-11.7)	11.1 (10.1-12.1)	12.6 (11.9-13.1)	14.8 (14.8-14.8)	11.3 (10.5-12.2)	
Range	9.1-13.1	8.9-13.2	10-14.7	14.8-14.8	8.9-14.8	
Platelet count/mean platelet volume						
Mean±SD	16.65±4.68	13.26±4.83	10.83±3.21	5.54±0	14.09±5.07	0.004§
Median (25th-75th percentile)	16.8 (13.9-18)	12.06 (10.56-16.95)	10 (9.04-12.9)	5.54 (5.54-5.54)	13.55 (10.51-17.185)	
Range	9-28.1	5.1-24.23	6.79-15.3	5.54-5.54	5.1-28.1	

§ANOVA

Table 4: Association of percentage change in platelet indices between third trimester and at delivery with severity of PIH.

Percentage change in platelet indices	Gestational HTN (n=21)	Pre eclampsia without severe symptoms (n=19)	Pre eclampsia with severe symptoms (n=9)	Eclampsia (n=1)	Total	P value
Percentage decrease in platelet count						
Mean±SD	22.43±12.86	29.6±18.43	31.02±11.28	51.19±0	27.27±15.48	0.143§
Median (25th-75th percentile)	21.43 (13.445-29.73)	30.77 (20.498-43.364)	36.41 (21.429-37.619)	51.19 (51.19-51.19)	26.22 (18.603-37.425)	
Range	2.99-50.42	-12.2-60	16.07-46.45	51.19-51.19	-12.2-60	
Percentage increase in MPV						
Mean±SD	8.22±6.26	9.73±4.57	16.6±11.12	16.54±0	10.47±7.34	0.023§
Median (25th-75th percentile)	8.08 (5.66-10.811)	9.38 (5.822-12.251)	16.3 (8.696-18.548)	16.54 (16.535-16.535)	8.86 (6.256-13.651)	
Range	-6.87-18.89	2.22-20.65	3.39-40	16.54-16.54	-6.87-40	
Percentage decrease in platelet count/mean platelet volume						
Mean±SD	28.28±12.85	35.5±17.78	42.48±8.96	58.09±0	34.18±15.38	0.035§
Median (25th-75th percentile)	27.64 (18.551-36.466)	36.07 (25.581-49.321)	42.36 (34.015-48.21)	58.09 (58.094-58.094)	34 (23.812-45.347)	
Range	1.64-53.85	-0.21-64.4	30.77-57.7	58.09-58.09	-0.21-64.4	

§ANOVA

Statistically significant decrease was seen in PC and PC/MPV after 32 weeks with severity of PIH in Table 2. It was least in gestational HTN followed by preeclampsia without severe symptoms, preeclampsia with severe symptoms. Maximum decrease was seen in eclampsia While there was increase in MPV with severity of PIH but was not statistically significant.

There was decrease in PC and PC/MPV at delivery with severity of PIH and was statistically significant and there is increase in MPV with severity of PIH which was also statistically significant as shown in Table 3.

Table 4 shows a decrease in mean PC between third trimester and delivery and the decrease was least in gestational HTN followed by pre-eclampsia without severe symptom, preeclampsia with severe symptom and maximum in eclampsia. And also, similar percentage decrease was seen in PC/MPV which was statistically significant. There was significantly more percentage increase in MPV with severity of PIH, maximum being in eclampsia.

Table 5: Receiver operating characteristic curve of platelet indices for predicting pregnancy induced hypertension.

Parameters	Platelet count (×10³/µl)	Mean platelet volume (fl)	Platelet count/mean platelet volume
Area under the ROC curve (AUC)	0.705	0.726	0.741
Standard error	0.0522	0.05	0.0496
95% confidence interval	0.606 to 0.792	0.628 to 0.811	0.644 to 0.823
P value	0.0001	<0.0001	<0.0001
Cut off	≤240	>10	≤24.8
Sensitivity (95% CI)	82% (68.6-91.4%)	54% (39.3-68.2%)	82% (68.6-91.4%)
Specificity (95% CI)	54% (39.3-68.2%)	82% (68.6-91.4%)	62% (47.2-75.3%)
PPV (95% CI)	64.1% (51.1-75.7%)	75% (57.8-87.9%)	68.3% (55.0-79.7%)
NPV (95% CI)	75% (57.8-87.9%)	64.1% (51.1-75.7%)	77.5% (61.5-89.2%)
Diagnostic accuracy	68.00%	68.00%	72.00%

Table 6: Receiver operating characteristic curve of platelet indices for predicting pre-eclampsia without severe symptoms.

Pre eclampsia without severe symptoms	Platelet count (×10³/µl)	Mean platelet volume (fl)	Platelet count/mean platelet volume
Area under the ROC curve (AUC)	0.722	0.535	0.618
Standard error	0.0813	0.0966	0.0916
95% confidence interval	0.558 to 0.852	0.371 to 0.694	0.451 to 0.767
P value	0.0064	0.7164	0.1986
Cut off	≤236	≤9.6	≤17.06
Sensitivity (95% CI)	89.47% (66.9-98.7%)	47.37% (24.4-71.1%)	31.58% (12.6-56.6%)
Specificity (95% CI)	47.62% (25.7-70.2%)	76.19% (52.8-91.8%)	100% (83.9-100.0%)
PPV (95% CI)	60.7% (40.6-78.5%)	64.3% (35.1-87.2%)	100% (54.1-100.0%)
NPV (95% CI)	83.3% (51.6-97.9%)	61.5% (40.6-79.8%)	61.8% (43.6-77.8%)
Diagnostic accuracy	67.50%	62.50%	67.50%

Table 7: Receiver operating characteristic curve of platelet indices for predicting pre-eclampsia with severe symptoms.

Pre-eclampsia with severe symptoms	Platelet count (×10³/µl)	Mean platelet volume (fl)	Platelet count/mean platelet volume
Area under the ROC curve (AUC)	0.62	0.632	0.611
Standard error	0.113	0.129	0.128
95% confidence interval	0.418 to 0.795	0.430 to 0.805	0.410 to 0.788
P value	0.2885	0.3082	0.3853
Cut off	≤224	>10.9	≤16.3
Sensitivity (95% CI)	100% (66.4-100.0%)	55.56% (21.2-86.3%)	44.44% (13.7-78.8%)
Specificity (95% CI)	26.32% (9.1-51.2%)	73.68% (48.8-90.9%)	84.21% (60.4-96.6%)
PPV (95% CI)	39.1% (19.7-61.5%)	50% (18.7-81.3%)	57.1% (18.4-90.1%)
NPV (95% CI)	100% (47.8-100.0%)	77.8% (52.4-93.6%)	76.2% (52.8-91.8%)
Diagnostic accuracy	50.00%	67.86%	71.43%

All the parameters had significant discriminatory power to predict pregnancy induced hypertension. Among all the parameters, PC/MPV ratio had the maximum diagnostic accuracy. PC/MPV ratio and Platelet count had maximum sensitivity. whereas, MPV had maximum specificity for the same. Highest positive predictive value was found in MPV and highest negative predictive value was found in PC/MPV.

There is always a trade-off between sensitivity and specificity (any increase in sensitivity will be accompanied by a decrease in specificity) so we choose that variable as best in which combination of sensitivity and specificity gives the maximum predictive value i.e., maximum diagnostic accuracy so overall PC/MPV was best predictor of PIH according to Table 5.

In Table 6 prediction of pre-eclampsia without severe symptoms discriminatory power of platelet count was only acceptable. Platelet count had maximum sensitivity and least of PC/MPV. On the other hand, PC/MPV had specificity of 100.00%. Highest positive predictive value was found in PC/MPV and highest negative predictive value was found in platelet count. So overall platelet count and PC/MPV was best predictor of pre-eclampsia without severe symptoms.

None of the parameter had significant discriminatory power to predict pre-eclampsia with severe symptoms. Interpretation of the area under the ROC curve showed that the performance of platelet count, MPV and PC/MPV was non-significant (Table 7).

Platelet count had maximum sensitivity and PC/MPV had lowest. On the other hand, PC/MPV had maximum specificity and PC had lowest. Highest positive predictive value was found in PC/MPV and highest negative predictive value was found in platelet count. Maximum diagnostic accuracy was seen PC/MPV ratio.

DISCUSSION

In the present study it was seen that PC was lower in cases as compared to normotensive patients in the third trimester as well as at time of delivery. There is a decrease in PC in pregnancy but the decrease was more in PIH patients which was statistically significant. And there was a significant more percentage decrease in PC from third trimester to delivery in cases in compare to control. This was similar to a study conducted by Gupta et al.[2]

In our study significant association was seen in PC with severity of PIH, the mean PC in third trimester was maximum in gestational HTN (236.1±38.45×103/µl), followed PE without severe symptom (204.47±38.4×103/µl), PE with severe symptom (191±24.86×103/µl) and lowest in eclampsia group (168±0×103/µl). Hence, in the present study severity of PIH and thrombocytopenia observed were closely correlated which indicates that thrombocytopenia is directly proportional to the severity of PIH. Similar results were observed at delivery. There was decrease in PC with severity of PIH, which was statistically significant.

Similar results were observed in the study done by Wael Ammar et al, Alkholy et al, Vijaya et al, Dadhich et al.[3,19,21,24] Despite the PC being normal (>1.5 lakh/cum) in all the cases included, it was observed that PC decreased as the severity of the disease increased.

Percentage decrease in PC between third trimester and delivery increases with the severity of PIH. The maximum decrease was in eclampsia and least was in gestational HTN. But statistical significance was not seen because the gestational period at delivery was different in sub groups. No similar study was found for percentage change in platelet count between third trimester and delivery and this need further research.

In the present study it was observed that MPV was more in cases as compared to control group when evaluated at the third trimester and similar results were seen when observed at delivery. There was marked increase in MPV from the third trimester to delivery both in cases and control groups. This percentage increase is seen more in cases (10.47±7.34 fl) as compared to control group (7.09±6.67 fl), which was statistically significant.

In our study MPV is seen in relation to the severity of PIH in third trimester, increase was seen with severity of PIH but was not statistically significant and at the time of delivery there was a gradual increase in MPV with the severity of PIH, which was 11.1±1 fl in gestational HTN, 11.12±1.3 fl in preeclampsia without severe symptom, 12.49±1.5 fl in preeclampsia with severe symptoms and maximum in eclampsia (14.8±0 fl) which was statistically significant.

This result was comparable to study done by Ammar et al, Alkholy et al which showed similar increase in relation with severity of PIH.[3,19]

Even on evaluating percentage change in third trimester and at delivery, there is least increase in gestational HTN which is 8.22±6.26, followed by 9.73±4.57 in PE without severe symptom and 16.6±11.12 in PE with severe symptom and maximum increase 16.54±0 was seen in eclampsia. And this was statistically significant.

In the present study PC/MPV ratio was evaluated after third trimester which was less in cases than in control group. Similar results were seen at delivery, was also statistically significant. There was a percentage decrease in PC/MPV in both cases and control from the third trimester to delivery, which was more in cases as compare to control group (p value <0.0001).

It was also seen that PC/MPV in third trimester, decreases with the severity of PIH, similar results were seen at delivery in relation to severity of PIH, both were statistically significant. There was a marked percentage decrease in PC/MPV ratio from third trimester to delivery with severity of PIH. It was decrease least in gestational HTN and maximum decrease was seen in eclampsia. The result was supported by Similar study done by AlSheeha et al.[4]

In our study ROC curves, show cut off value of ≤240×10³/µl PC with sensitivity of 82% and specificity of 54% in predicting PIH with diagnostic accuracy of 68%. We also observed cut off value of ≤236×10³/µl of PC which has 72.20% chances of correctly predicting preeclampsia without severe symptoms from gestational hypertension with sensitivity of 89.47% and specificity of 47.62% which is lowest among other platelet indices and its diagnostic accuracy of 67% only. It was observed to

have a cut off value of ≤224×10³/µl platelet count and sensitivity of 100.00% and specificity of 26.32% which was lowest in predicting preeclampsia with severe symptoms from PE without severe symptom with diagnostic accuracy of 50%. MPV cut off value was >10 fl in predicting PIH with sensitivity of 54% and specificity of 82% and diagnostic accuracy same as of PC. While MPV cut off value in predicting preeclampsia without severe symptoms, with sensitivity of 47.37% and specificity of 76.19% which was not statistically significant, with diagnostic accuracy of 62.5% and for predicting preeclampsia with severe symptoms MPV cut off value was >10.9 fl, having a sensitivity of 55.56% and specificity of 73.68% with diagnostic accuracy of 67.86%. while that of PC/MPV cut off value was ≤24.8 in predicting PIH with sensitivity of 82% and specificity of 62% with maximum diagnostic accuracy (72%), while cut off value was ≤17.06 in predicting preeclampsia without severe symptoms with sensitivity of 31.58% and specificity of 100% and diagnostic accuracy of 67.5% while predicting preeclampsia with severe symptoms from preeclampsia without severe symptoms cut off value was ≤16.3. It has sensitivity of 44.44% and specificity of 84.21% and maximum diagnostic value.

In contrast to this, a study done by Ammar et al found that a platelet count cut off value of 168,000/mm^3 showed sensitivity =87.5% and specificity =72.1% in differentiating mild from severe preeclampsia.[19] They also found that MPV cut off value of 10.3 fl with sensitivity 87.5% and specificity 85.3% in differentiating mild from severe preeclampsia. while PC/MPV values were significantly lower in the cases compared with the controls i.e. 22.2 (16.8-29.7) and 26.1 (20.5-32.0) respectively but they found there was no significant difference when mild and severe preeclampsia women were compared. The PC/MPV cut off was 31.2 for diagnosis of preeclampsia. The area under the ROC curve was 62.2%, and the standard error was 5.2%

Similar study done by Alkholy et al found that from ROC curve analysis, PC can differentiate normotensive pregnant women from mild PE patients with a sensitivity of 90% and specificity of 92% and can differentiate mild PE from severe PE patients with sensitivity of 84% and specificity of 92%.[3] While MPV cut off value was ≥ 9.3 fl with sensitivity of 90% and specificity of 92% and can differentiate mild from severe PE at a cut off value ≥10.4 fl with sensitivity of 82% and specificity of 92%. Which was higher than our study.

When postpartum complication like PPH, DIC, UTI, pulmonary edema were compared it was more in cases as compared to control and were included in bad prognosis, but no statistical significance was seen. Among which DIC, imminent eclampsia and pulmonary edema were some complications seen only in the case group. Same was observed with the severity of PIH, that is there was a maximum percentage risk of bad prognosis in eclampsia as compared to gestational HTN, and was statistically significant (p value 0.04). When postpartum complication was compared with PC and platelet indices no statistical significance was seen with severity of PIH with respect to maternal complication.

Similar study was done by Ammar et al and they concluded that good and bad maternal prognosis (poor maternal prognosis were complicated by eclampsia, death from brain insult, pulmonary oedema, reversible acute tubular necrosis and HELLP syndrome) was good when (PLT count =144,000±30,317/mm^3, MPV=10.9±0.9 fl) and maternal prognosis was poor when (PLT count =95,330±16,269/mm^3, MPV=12.9±0.6 fl).[19] So when platelet indices were (low PLT count, high MPV) the maternal prognosis was poor.

When NICU admission were observed it was more in cases (32%) with respect to the control group (26%). Maximum percentage of NICU admission was in eclampsia followed by PE with severe symptoms and least in gestational HTN. NICU admissions was seen in babies with complications like respiratory distress, low birth weight, meconium aspiration, jaundice and IUGR and have unfavorable outcomes.

In the present study, NICU admission was observed with severity of PIH with respect to platelet count and platelet indices and no statistical significance was seen.

There was no difference in the mean value of platelet count, MPV and PC/MPV ratio in patients whose neonate needed NICU admission and not needing NICU admission with respect to severity of PIH.

In contrast to this, study done by Ammar, et al found severe preeclamptic women whose neonates needed admission to NICU had a significantly low PC, while the MPV significantly higher than those whose neonates did not need admission to NICU.[19]

This study has some limitations. In the present study, there was a small cohort of patients and larger sampling is needed for better statistical interpretation. Our study did not take into account socio demographic parameters like race, ethnicity, socioeconomic status, education, nutritional status, prenatal care etc. Secondly patients were followed up only till the time they stayed in the hospital, hence long-term outcome could not be accessed. It did not take into account all the platelet indices parameter (PDW and PLcr) in predicting the prognosis and lastly very limited data and research studies are available, creating hindrance to find any association.

CONCLUSION

Finally, to conclude it was seen that with severity in PIH, PC and PC/MPV decreases while MPV increases. That is, there was a statistically significant percentage decrease in PC and PC/MPV and increase in MPV from third trimester to the time of delivery with severity of PIH. ROC curve

PC/MPV shows maximum diagnostic accuracy that is 72% in predicting PIH, 67.5% in predicting PE without severe symptoms from gestational hypertension and 71.43% in predicting PE with severe symptoms from PE without severe symptoms. Thus, the estimation of PC and platelet indices method can be considered as an economical and rapid procedure of assessment of severity of PIH and progression of PIH.

But alone it cannot be relied upon to assess the severity of PIH. Hence, more research is required in this field for platelet indices to be used as an ideal screening test for early identification of PIH and the prediction of its severity.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kaushik N, Jain G, Singh PN, Ahmed QR, Rawat M, Chaudhuri S, et al. Thrombocytopenia in pregnancy induced hypertension. Int J Physiol. 2019;7(3):138-40.
2. 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.
3. Alkholy EA, Farag EA, Behery MA, Ibrahim MM. The significance of platelet count, mean platelet volume and platelet width distribution inpreeclampsia. AAMJ. 2013;11(1):200.
4. AlSheeha MA, Alaboudi RS, Alghasham MA, Iqbal J, Adam I. Platelet count and platelet indices in women with preeclampsia. Vasc Health Risk Manag. 2016;12:477-480.
5. Tejeswini KK, Anitha GS, Nandagopal KM. Platelet count as a prognostic indicator in pregnancy induced hypertension. Int J Reprod Contracept Obstet Gynecol. 2016;5(4):1036-47.
6. Tesfay F, Negash M, Alemu J, Yahya M, Teklu G, Yibrah M, et al. Role of platelet parameters in early detection and prediction of severity of preeclampsia: a comparative cross-sectional study at Ayder comprehensive specialized and Mekelle general hospitals, Mekelle, Tigray, Ethiopia. PloS One. 2019;14(11):e0225536.
7. ACOG Practice Bulletin, Number 222. Gestational Hypertension and Preeclampsia. Obstet Gynecol. 2020;135(6):1492-5.
8. Onuigwe FU, Udoma FP, Dio A, Abdulrahaman Y, Erhabor O, Uchechukwu NJ. Platelet count in women with pregnancy induced hypertension in Sokoto, North Western Nigeria. Res Obstet Gynaecol. 2015;3(1):1-4.
9. Nabi S, Sharma K. Are lowered blood platelet counts an indication of hypertension among pregnant women? Indian J Appl Res. 2019;9(2).
10. Onuigwe FU, Udoma FP, Dio A, Abdulrahaman Y, Erhabor O, Uchechukwu NJ. Platelet count in women with pregnancy induced Hypertension in Sokoto, North Western Nigeria. Research in Obstetrics and Gynaecology. 2015;3(1):1-4.
11. Reddy SG, Rajendra Prasad CS. Significance of platelet indices as severity marker in nonthrombocytopenic preeclampsia cases. J Lab Phys. 2019;11:186-91.
12. Shekhawat H, Shrivastava D. Assessment of platelet indices in pregnancy induced hypertensive patients versus normotensive pregnant patients. Int J Reprod Contracept Obstet Gynecol. 2019;8(5):2091-5.
13. Dhakre R, Nandmer GK, Sapkal R. Correlation of platelet indices with severity of pre-eclampsia: a prospective study from central India. Int J Reprod Contracept Obstet Gynecol. 2018;7(4):1416-21.
14. Meghana P, Bharathi M. 2018. Platelet count and platelet indices in hypertensive disorders of pregnancy. Int J Rec Scient Res. 2018;9(2):24571-3.
15. Thalor N, Singh K, Pujani M, Chauhan V, Agarwal C, Ahuja R. A correlation between platelet indices and preeclampsia. Hematol Transfus Cell Ther. 2019 41(2):129-33.
16. Manchanda J, Malik A. Study of platelet indices in pregnancy-induced hypertension. Med J Armed Forces India. 2020;76(2):161-5.
17. Amita K, Nithin Kumar H, Shobha SN, Shankar V. The role of platelet parameters as a biomarker in the diagnosis and in predicting the severity of preeclampsia. Indian J Pathol Oncol. 2015;2(2);57-60.
18. Mondal B, Paul DL, Sultana T, Rahman Q, Ahmed S, Fatema K, et al. Assessment of platelet count and platelet indices in preeclampsia and eclampsia. Am J Innov Res Appl Sci. 2015;1(3):80-4.
19. Kamel Ammar WA, Abd El MA, Hei MA, Mohamed MI. Evaluation of platelet indices and their significance in Preeclampsia. Nat Sci. 2014;12(3):147-53.
20. Mohammed FE, Khalil HB, Idriss MI, Mohamadein Abdalla TE, Elnoman Elbadawi NE. Variations of platelets indices in pregnancy induced hypertension. J Physiobiochem Metab. 2013;2:1.
21. Vijaya C, Lekha MB, Shetty A, Geethamani V. Evaluation of platelet counts and platelet indices and their significant role in pre-eclampsia and eclampsia. J Evol Med Dent Sci. 2014;3(12):3216-20.
22. Damani Z. Platelet count in women with pregnancy induced hypertension in university hospital center of mother and child healthcare "Koco Gliozheni", Tirana, Albania. Mater Socio-Med. 2016;28(4):268.
23. Freitas LG, Alpoim PN, Komatsuzaki F, Carvalho MD, Dusse LM. Preeclampsia: are platelet count and indices useful for its prognostic?. Hematology. 2013;18(6):360-4.
24. Dadhich S, Agrawal S, Soni M, Choudhary R, Jain R, Sharma S, et al. Predictive value of platelet indices in development of preeclampsia. J South Asian Feder Obst Gynaecol. 2012;4(1):17-21.

25. Katke RD, Gohil DP. Thrombocytopenia during pregnancy: an institutional based study. Int J Reprod Contracept Obstet Gynecol. 2014;3:947-51.

Cite this article as: Saini N, Gautam R, Jeyaseelan S. Utility of platelet count and platelet indices as a prognostic indicator in pregnancy induced hypertension. Int J Reprod Contracept Obstet Gynecol 2022;11:3053-61.