National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Feasibility of mean platelet volume in predicting neonatal morbidity in pre-eclamptic pregnancies

Samreen Farooqui, Rashmi Tiwari, Pushpalata Sachan

Department of Physiology, Career Institute of Medical Sciences and Hospital, Lucknow, Uttar Pradesh, India

Correspondence to: Rashmi Tiwari, E-mail: drrashmimishra27@gmail.com

Received: July 15, 2019; **Accepted:** August 12, 2019

ABSTRACT

Background: Mean platelet volume (MPV) is a measurement of the average size of platelets found in blood. The average platelet size is larger when the body is producing increased numbers of platelets. Hence, the MPV test results can be used to make inferences about platelet production in bone marrow or platelet destruction problems. MPV is higher when there is destruction of platelets. Since pregnancy is a hypercoagulable state and pre-eclampsia is one of the risk factors associated with low birth weight babies and fetal growth retardation, the newborns of hypertensive mothers should thus be very carefully evaluated in terms of platelet abnormalities. **Aims and Objectives:** This study aims to study the MPV and platelet counts in neonates born of pre-eclamptic and normal pregnancies. **Materials and Methods:** This is a case–control study performed in the department of physiology in collaboration with other departments. A total of 40 cases and 40 controls were enrolled. Venous blood from mothers was collected in ethylenediaminetetraacetic acid vials. MPV was assessed using an automated cell counter machine placed in hospital laboratory service. **Results:** In the present study, the values of MPV in neonates of case group (10.2 ± 0.94 fL) and control group (10.01 ± 1.06 fL) are approximately the same and not significant ($P > 0.05$). **Conclusion:** Our results showed that platelet counts showed significant decrease in the case group compared to controls while the levels of MPV did not differ much among patients with pre-eclampsia and healthy pregnant women. Further studies are needed to explore the adequacy of MPV as a marker of pre-eclampsia.

KEY WORDS: Pre-eclampsia; Platelet Count; Mean Platelet Volume; Umbilical Cord Blood

INTRODUCTION

Hypertensive disorders are one of the foremost complications of pregnancy forming a major source of maternal mortality and morbidity worldwide[1] affecting the growth of neonates as well *in utero*. The different forms of hypertension are gestational, chronic essential hypertension, pre-eclampsia, and eclampsia.[1] Pre-eclampsia is described as onset of hypertension (≥140/90 mmHg) associated with proteinuria (equal to or above 300 mg per 24 h) post 20 weeks gestation in a pregnant female with no previous history of hypertension.[2-4] Usually, pre-eclampsia does not show symptoms, but in severe cases, it may be present with headache, epigastric pain, disturbances of vision, and changes in consciousness.[1,3]

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2019.9.0828412082019	

Approximately 2–8% of pregnancies are complicated by pre-eclampsia. Often, the outcome is good, but it is an important cause of both maternal and neonatal morbidity and mortality.[5,6] The prevalence of pre-eclampsia in developing countries ranges somewhere from 1.8% to 16.7%.[7]

Pre-eclampsia is a major maternal risk factor and is often associated with low birth weight babies and fetal growth restriction.[1] It is considered to be a state of uteroplacental

perfusion deterioration with inadequate blood supply to fetus which results in fetal exposure to hypoxic or oxidative stress in the placenta. In response to this stress, the hypoxic placenta releases certain factors into maternal blood which being vasoactive alter the permeability of the endothelial layer and change the vascular reactivity to this stress.[8] As a result of the injury to the endothelium, platelets become activated and release their contents such as thromboxane A2 and serotonin which lead to vasoconstriction and activation of coagulation cascade. This activation of the coagulation cascade combined with a decrease in fibrinolytic properties and impaired clearance of fibrin interferes with the microcirculation of organs such as liver, CNS, kidneys, and placenta. This causes the development of biochemical and clinical features of the disease.[9]

Hypertensive disorders are very common in pregnancy and tend to complicate approximately 10% of all pregnancies. They can result in severe complications for the mother such as eclampsia, abruptio placentae, premature delivery, and HELLP syndrome. Sometimes, they ultimately lead to neonatal and maternal deaths.[1,9]

Pre-eclampsia is prevalent globally contributing to maternal and perinatal morbidity and mortality. The findings of pre-eclampsia can present either as a maternal syndrome consisting of hypertension, proteinuria with or without edema, and other multiorgan abnormalities or it can present as a fetal syndrome comprising fetal growth restriction, decrease in amniotic fluid, and abnormal placentation.[10]

In India, the incidence of pre-eclampsia among inpatient department patients is about 7–10% of pre-delivery admissions.[11]

Maternal blood provides the only source of nutrients for the growing fetus.[12] Umbilical cord blood is the true indicator of hematological values at birth as it is not affected by hemodynamic changes that take place within a few hours of birth.[13]

It has been shown that hematological changes such as thrombocytopenia and a decrease in a few clotting factors in plasma may develop in pre-eclamptic women.[14]

Increase in size of platelets has been found in conditions with an exaggerated platelet destruction and use. This increment in platelet size can be found in patients with normal platelet counts in moderate to severe hypertension during pregnancy.[15]

Mean platelet volume or MPV measures the average size of the platelets in circulation. The platelet size on an average is larger when the body produces an increased number of platelets. Evidence shows that MPV is increased when both the formation and destruction of platelets are increased. The cytokines which mediate these processes are probably interleukins 3 and 6 (IL 3 and IL 6) and thrombopoietin. Studies also show that larger platelets are more reactive, with an increased production of thromboxane A2, aggregate more easily *in vitro*, contain an increased amount of dense granules, and exhibit an enhanced expression of membrane receptors.[16]

Deductions can be made about the platelet production in bone marrow or platelet destruction problems from the results of the MPV test. An increased MPV is present when there is a destruction of platelets. Since pregnancy is a hypercoagulable state with pre-eclampsia being one of the risk factors associated with low birth weight babies and fetal growth retardation, the neonates of hypertensive mothers should, thus, be very carefully evaluated in terms of platelet abnormalities.

Studies corresponding to MPV and platelets are few and results are conflicting.[9-12,14-15]

Against this backdrop of the current scenario of conflicting results, the present study was carried out to evaluate the changes in platelet count and MPV in umbilical cord blood of neonates born to pre-eclamptic mothers and compared with those born from a healthy pregnancy.

MATERIALS AND METHODS

The present study is a cross-sectional study which was conducted in the Department of Physiology in collaboration with the Department of Obstetrics and Gynaecology and Department of Pathology of Era's Lucknow Medical College and Hospital (ELMCH), Lucknow. The period of study was 18 months. Forty cases and 40 controls were taken in each group.

Inclusion Criteria

Cases: Neonates from pre-eclamptic pregnancies delivered in ELMCH, Lucknow. Control: Neonates from normal healthy pregnancies delivered in ELMCH, Lucknow.

Exclusion Criteria

Pregnant women if:
Not delivered in Era's Lucknow Medical College and Hospital

- They have had any chronic diseases
- They had a previous blood transfusion
- Recent infections
- If there is an ABO incompatibility
- If there is an Rh incompatibility
- If the subject has bleeding disorders of any kind
- Subjects who did not give consent.

All patients were explained about the study protocol. An informed consent was obtained. After enrolment in the study, a general and systemic examination was done. A special emphasis was laid on the blood pressure of pregnant women. Urine of mothers was analyzed for the presence of proteins using urinary dipsticks.

In this study, the umbilical cord blood sample of neonates (2 ml) was taken at birth for both cases and controls. All the blood samples were collected in ethylenediaminetetraacetic acid vials and were analyzed using the automated cell counter machine (SYSMEX KX21) placed in the Hospital Laboratory Service for platelet count and MPV. Birth weight of the baby was noted in kilograms.

Ethical Clearance

This study was approved by the Institutional Ethical Committee and an informed consent was taken from the patients in writing.

Statistical Analysis

The data collected were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 16.0. Means of hematological values (between cases and controls) were compared using paired "*t*"-test. Means of birth weight of neonates both in case and control group were also compared using the paired "*t*"-test. The confidence interval was kept at 95% in this study; hence, "*P*"<0.05 was considered to be statistically significant. Generation of graphs and tables was done by Microsoft Excel and Microsoft Word version 2007.

RESULTS

Table 1 shows gender distribution of newborns in the study and control group. In the control group, 12 newborns (30%) are male and 28 newborns (70%) are female. In the study group, 14 newborns (35%) are male and 26 (65%) are female. Table 2 shows that in the study group, 12 newborns (30%) were below 2.5 kg and 28 newborns (70%) were above 2.5 kg. In the control group, 6 newborns (15%) were below 2.5 kg and 34 newborns (85%) were above 2.5 kg. There was a significant difference in the outcome of babies in terms of birth weight in pre-eclampsia when compared to normal healthy pregnancies ($P < 0.05$). Table 3 shows that in the present study, the platelet count in the neonatal case group (199.23 ± 56.76) is significantly lower than the neonatal control group (223 ± 49.1) with $P = 0.05$. The MPV in the case group neonate (10.2 ± 0.94) and control group neonate (10.01 ± 1.06) is approximately the same in both the groups and not significant ($P > 0.05$).

Table 1: Gender-wise distribution of neonates in the study and control group

Gender	Cases (*n*=40)	Controls (*n*=40)
	Number of newborns (%)	Number of newborns (%)
Male	14 (35)	12 (30)
Female	26 (65)	28 (70)

DISCUSSION

This study found that there was a decrease in the platelet counts significantly in cases compared to controls. Although there was a decrease in the MPV, it was not significant.

In this study, birth weight in the case group (2.617 ± 0.27 kg) was found to be significantly lower than the birth weight in the control group (2.764 ± 0.29 kg) ($P < 0.05$). The same results were also found in the study done by Al Bayati *et al*., in 2011, where they also showed lower birth weight in neonates born to pre-eclamptic women (2920.20 ± 488.37 g) than those from normal healthy pregnancies (3248 ± 279.39 g), the difference being statistically significant ($P < 0.001$).[17] Furthermore, a study done in the year 2014 by Hebbar *et al*. also showed reduced birth weights in neonates from pre-eclamptic mothers (2171 ± 805.3 g) compared to those from healthy pregnancies (2976.1 ± 473.3 g) which were also statistically significant ($P < 0.001$).[18]

Platelet activation is assessed in terms of reduced thrombocyte count, an elevated MPV, raised β-thromboglobulin, and platelet factor 4.[19] These are elevated in pregnancy-induced hypertension (PIH) much before the onset of clinical symptoms and hence may be useful as predictors for the onset of the disease and also indicate the severity.[20]

MPV is one of the signals of the activation of platelets and it can be easily measured by automated analyzers. It is routinely done during antenatal checkup.[19]

Few studies have been done regarding the feasibility of using MPV as markers in PIH and have shown contradictory results. They have shown that there is an increase in size of thrombocytes[21] and increase in MPV in patients with

Table 2: Birth weight distribution of newborns in the study and control groups

Birth weight	Cases (*n*=40)			Controls (*n*=40)			*t*-value	*P*-value
	Number of newborns	%	Mean±SD	Number of newborns	%	Mean±SD		
B. wt. <2.5 kg	12	30	2.617±0.27	6	15	2.764±0.29	-2.2	0.034
B. wt. ≥2.5 kg	28	70		34	85			

Table 3: Distribution of platelet count and MPV in newborns in the study and control groups

Variables	Cases (Mean±SD)	Controls (Mean±SD)	*t*-value	*P*-value
Platelet count	199.23±56.76	223±49.1	2.012	0.05
Mean platelet volume	10.005±1.06	10.2±0.94	0.953	0.35

moderate to severe hypertension in pregnancy,[22] whereas another study showed that there was no change in the MPV in cases with mild to moderate hypertension.[10]

In a study done by Ioannis *et al.*[10] found that there was no change in MPV in patients with a normal blood pressure as well as PIH group during the 3rd trimester. However, another study done by Singer *et al.*[22] showed that there is an elevation in MPV in patients with moderate to severe hypertension in pregnancy. Giles and Inglis[21] also showed that there was a significant increase in platelet size with an MPV>10.4 in hypertensive pregnant women who presented with or without edema but without proteinuria. A study done by Yin *et al*.[23] also showed that MPV in PIH was greater than that of controls. In the present study, even though MPV was within normal range, our study reported that MPV was increased more than the normal value (>10.4) in six cases, of which four of them had systolic blood pressure >150 mmHg and two of them had diastolic blood pressure >90 mmHg. This indicates the association of MPV with pre-eclampsia. A study done by Dadhich *et al.*[24] showed similar results that there was a rise in MPV values in pre-eclampsia patients (44.5%) with the duration of gestation as blood pressure increased. The increase was more significant as severity of pre-eclampsia increased (46.26% in mild pre-eclampsia vs. 51.02% in severe pre-eclampsia).

Limitations of the Study

The sample size of the study is small. Larger prospective studies are required and the follow-up from early pregnancies is needed to reach a conclusion.

CONCLUSION

MPV indicates platelet function and also increased number of immature platelets in the bone marrow. An increased MPV signals platelet activation which can be escalated even before the onset of clinical symptoms. Hence, any elevation in MPV can be considered as a warning and patients can be kept under surveillance more carefully to prevent any detrimental consequences. Studies associating MPV and platelets are few and reports are conflicting.[25-27] This study was done to know MPV variability from neonates born of healthy pregnancies and in those born of pre-eclamptic pregnancies. Our results deduced that MPV level did not have much difference in neonates born from PE and those from neonatal healthy pregnancies. Further studies are needed to explore the adequacy of MPV as a marker of pre-eclampsia.

REFERENCES

1. Gabbe SG, Niebyl JR, Simpson JL. Obstetrics: Normal and Problem Pregnancies. 5th ed. Philadelphia, PA: Churchill Livingstone; 2007. p. 863-6.
2. Catarino C, Rebelo I, Beloi L, Quintanilha A, Santos-Silva A. In: Sifakis S, editor. Umbilical Cord Blood Changes in Neonates from a Preeclamptic Pregnancy, from Preconception to Postpartum. Croatia: In Tech; 2012.
3. Dutta DC. Textbook of Obstetrics. 6th ed. Ch. 17. New Delhi: New Central Book Agency; 2004. p. 221-42.
4. Aali BS, Malekpour R, Sedig F, Safa A. Comparison of maternal and cord blood nucleated red blood cell count between pre-eclamptic and healthy women. J Obstet Gynaecol Res 2007;33:274-8.
5. Catarino C, Rebelo I, Beloi L, Petronila RP, Rocha S, Castro EB, *et al*. Erythrocyte damage aging/removal are enhanced in both mother and fetus, in preeclampsia. Actas Bioquim 2008;9:63-7.
6. Altman D, Carroli G, Duley L, Farrell B, Moodley J, Neilson J, *et al.* Do women with pre-eclampsia, and their babies, benefit from magnesium sulphate? The magpie trial: A randomised placebo-controlled trial. Lancet 2002;359:1877-90.
7. Osungbade KO, Ige OK. Public health perspectives of preeclampsia in developing countries: Implication for health system strenghtening. J Pregnancy 2011;2011:6.
8. Crosbie E, Heazell A, Pickersgill A, Slade R. Preeclampsia and eclampsia. In: Key Clinical Topics in Obstetrics and Gynaecology. London: JP Medical Ltd.; 2014. p. 290-3.
9. Ballegeer VC, Spitz B, De Baene LA, Van Assche AF, Hidajat M, Criel AM, *et al.* Platelet activation and vascular damage in gestational hypertension. Am J Obstet Gynecol 1992;166:629-33.
10. Karalis I, Nadar SK, Al Yemeni E, Blann AD, Lip GY. Platelet activation in pregnancy-induced hypertension. Thromb Res 2005;116:377-83.
11. Moodley J. Management of hypertension in pregnancy. J Cont Med Educ 1991;9:72.
12. Gawde A, Bhosale UT. A study of maternal and perinatal outcome in preeclampsia. Int J Recent Trends Sci Technol 2014;10:267-70.
13. Babay ZA, Addar MH, Warsy AS, El-Hazmi MA. The inter-relationship hematological parameters between Saudi newborns and parents. Saudi Med J 2002;23:943-6.
14. Swetha AG, Puranik N, Kammar KF. A comparative study on coagulation profile and neutrophil-lymphocyte ratio in pregnancy-induced hypertension. Natl J Physiol Pharm Pharmacol 2018;8:400-5.
15. Walker JJ, Cameron AD, Bjornsson S, Singer CR, Fraser C. Can platelet volume predict progressive hypertensive disease in pregnancy? Am J Obstet Gynecol 1989;161:676-9.
16. ClinLab Navigator. ClinLab Navigator LLC. Mean Platelet Volume; c2015. Available from: http://www.clinlabnavigator.com/mean-platelet-volume.html?letter=M. [Last accessed on 2013 Jan 26; Last accessed on 2017 Mar 15].

17. Kumar A, Singh J, Kumar I. To study the relation of anthropometric factors with total and differential leucocyte count in healthy newborns. Pediatr Rev 2016;3:527-32.
18. Al-Bayati MM, Jameel BS, Suhial TM, Melkon AA. Maternal and cord blood nucleated red blood cells count in women with preeclampsia. Iraqi J Community Med 2011;24:302-7.
19. Hebbar S, Misha M, Rai L. Significance of maternal and cord blood nucleated red blood cell count in pregnancies complicated by preeclampsia. J Pregnancy 2014;2014:496416.
20. Lazarov R, Konijnenberg A, van der Post JA, Sturk A, Boer K. Preeclampsia not (yet) predictable from the blood platelet count. Ned Tijdschr Geneeskd 1999;143:10-13.
21. Giles C, Inglis TC. Thrombocytopenia and macrothrombocytosis in gestational hypertension. Br J Obstet Gynaecol 1981;88:1115-9.
22. Singer CR, Walker JJ, Cameron A, Fraser C. Platelet studies in normal pregnancy and pregnancy-induced hypertension. Clin Lab Haematol 1986;8:27-32.
23. Yin SM, Li YQ, Xie SF, Ma LP, Wu YD, Nie DN, *et al.* Study on the variation of platelet function in pregnancy induced hypertension and gestational diabetes mellitus. Zhonghua Fu Chan Ke Za Zhi 2005;40:25-8.
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 Fed Obstet Gynaecol 2012;4:17-21.
25. Yavuzcan A, Cağlar M, Ustün Y, Dilbaz S, Ozdemir I, Yildiz E, *et al.* Mean platelet volume, neutrophil-lymphocyte ratio and platelet-lymphocyte ratio in severe preeclampsia. Ginekol Pol 2014;85:197-203.
26. Makuyana D, Mahomed K, Shukusho FD, Majoko F. Liver and kidney function tests in normal and pre-eclamptic gestation a comparison with non-gestational reference values. Cent Afr J Med 2002;48:55-9.
27. AlSheeha MA, Alaboudi RS, Alghasham MA, Iqbal J, Adam I. Platelet count and platelet indices in women with preeclampsia. Vasc Health Risk Manag 2016;12:477-80.

How to cite this article: Farooqui S, Tiwari R, Sachan P. Feasibility of mean platelet volume in predicting neonatal morbidity in pre-eclamptic pregnancies. Natl J Physiol Pharm Pharmacol 2019;9(10):1034-1038.

Source of Support: Nil, **Conflict of Interest:** None declared.