Is Mean Platelet Volume is a Predictor of Pre-Eclampsia and Its Severity

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Abstract

Objective: To determine the worth of mean platelet volume in the prediction of risk and severity of pre-eclampsia in pregnant women. **Methodology:** This prospective cross-sectional study was conducted in the Department of Obstetrics and Gynaecology Bahawal Victoria Hospital, Bahawalpur. A sample of 200 patients was taken by non-probability consecutive sampling technique. Patients were divide in three groups as Normal Blood pressure, mild pre eclampsia and sever pre eclampsia according to Blood pressure recording. The age, gravidity, parity, number of abortions, gestational weeks were documented. Platelet counts, and mean platelet volume values were recorded. Data was analyzed using the software SPSS v.23. One way ANOVA test was applied. A p-value of <0.05 was considered significant.**Results:** A total number of 200 patients were enrolled in this study of which 94 patients were normal, seventy were mildly pre-eclamptic and 36 were severely pre-eclamptic. The mean age, gravidity, parity, no. of abortions and gestational weeks of the patients were 28.24±5.82 years, 2.89±1.25, 1.25±0.97, 0.65±0.86, and 29.35±4.77 weeks, respectively. The platelet count of normal patients, in mildly pre-eclamptic and in severely pre-eclamptic was 263200.7±53918.6, 201546.49±36916.36 and 170379.61±34475.69, respectively. The difference was statistically significant, (p= 0.000). The mean platelet volume of normal patients, in mildly pre-eclamptic and in severely pre-eclamptic was 7.58±1.14, 8.44±1.42, and 9.36±1.12 FL, respectively. The difference was also statistically significant, (p=0.000).**Conclusion:** Current study reveals that platelet count and mean platelet volume vary according to severity of pre-eclampsia. Platelet count decreases while mean platelet volume increases with increase in severity of pre-eclampsia. Subsequently, platelet count to mean platelet volume ratio also decreases with increasing severity. In short, these parameters can be helpful in predicting the risk and severity of pre-eclampsia at a much lower cost.

Keywords: pre-eclampsia, platelet count, mean platelet volume

Introduction

During pregnancy pre-eclampsia is considered to be one of the major health problems [1]. Three to eight percent pregnancies are complicated in the form of considerable rise in perinatal maternal morbidity and mortality [2]. Pre-eclampsia is defined as blood pressure of at least 140/90 mmHg documented on at least two different occasions, at least 4 hours apart, associated with minimum of 300mg of protein in a urine collection of 24 hours occurring *de novo* after 20th gestational week in a previously normotensive woman and it resolved completely after 6th postpartum week [3][9]. Pre-eclampsia can also develop in a patient suffering from chronic hypertension prior to pregnancy. Genetic predisposition, abnormal immunological interactions, endothelial damage and dysfunction are thought to play a significant role in its incidence but the exact etiology is not yet known [4]. Some risk factors for pre-eclampsia are first pregnancy, multi-parity with history of pre-eclampsia, BMI of 35 or more, family history, age 40 years or above and multiple pregnancy [5][11]. Certain underlying medical conditions e.g. pre-existing hypertension, pre-existing renal disease, pre-existing diabetes and anti-phospholipid antibodies have also been known to increase risk of pre-eclampsia [11].

Not much is known about the pathophysiology of pre-eclampsia. Genetic predisposition is a major role player as there has been a three to four fold increase in risk of developing pre-eclampsia in first degree relative of affected woman. The proposed mechanism of development of pre-eclampsia starts with deficient invasion by trophoblastic cells of maternal vascular bed due to some abnormal immunological response [6][7][9]. This results in placental hypo perfusion leading to extensive maternal endothelial dysfunction and increase in vascular permeability. When platelets come in contact with injured endothelium, it results in activation of the coagulation cascade which leads to increase in platelet depletion and consequent increased production of platelets by bone marrow. Normal pregnancy is associated with peripheral vasodilation but in pre-eclampsia, vasoconstriction occurs leading to increased intra-vascular pressure which along with increased vascular permeability due to dysfunctional endothelium results in generalized edema. Glomeruloendotheliosis occurs in kidneys which is quite specific for pre-eclampsia [9]. It is associated with impaired glomerular filtration and loss of intermediate proteins e.g. albumin and transferrin into the urine

Due to activation of coagulation system, platelet consumption is increased. Bone marrow produces large number of platelets in short time to compensate for ongoing loss of platelets which results in large sized platelets in circulation. Many indices are used to assess platelet function which include platelet count, mean platelet volume, platelet count to mean platelet volume ratio and platelet distribution width [8]. It is proposed that mean

platelet volume should increase owing to rapid increase in production of platelets in pre-eclampsia which should subsequently decrease platelet count to mean platelet volume ratio. Platelet count to mean platelet volume ratio is also dependent on number of platelets present in circulation, therefore, mean platelet volume needs to be focused for its role in prediction of severity of pre-eclampsia. Several studies suggest that the platelet count is low in pre-eclampsia even in the face of increased production of platelets in marrow due to over-activation of platelets [9].

Pre-eclampsia complicates 3-8% of pregnancies with drastic outcomes. There is need to develop some criteria to predict the severity of pre-eclampsia in order to minimize the risk of perinatal maternal morbidity and mortality as well as fetal complications. This can help improve the standards of provision of medical facilities in time before complications arise or pre-eclampsia progresses to eclampsia [10] [11]. Postpartum complications can also be prevented which will help to improve standard of maternal and fetal health and care. very few studies have been performed to assess the efficacy of various platelet indices as predictors of severity of pre-eclampsia but results have been controversial so far. So we decide to conduct this study which will help to provide local data for treatment guideline development and also base for future research on this very important subject.

Material and methodology

This prospective cross-sectional study was undertaken after taking consent from ethical committee of Bahawal Victoria Hospital, Bahawalpur. The duration of study was from July, 2016 to December, 2017. The study was conducted in The Department of Obstetrics and Gynaecology Bahawal Victoria Hospital, Bahawalpur.

Sample size was taken as 200 patients and it was calculated using the reference study by Pınar KUMRU et al [12]. Non-probability consecutive sampling technique was used. Patients who presented in outpatients department, admitted and treated in Bahawal Victoria Hospital, Bahawalpur were included in our study. Patients were divide in three groups as Normal Blood pressure, mild pre eclampsia and sever pre eclampsia according to Blood pressure recording. Informed consent was taken. Blood pressure of 140/90mmHg was taken as the lowest limit for pre-eclampsia and a blood pressure of 160/110 as lower limit for severe pre-eclampsia. A blood sample of 5cc was obtained from the antecubital veins to be used for full blood count. All samples were analyzed within 1-4 hours of collection in order to minimize the chances of any variation in platelet count and size. Coulter STKS system (Manufactured by Coulter Co., Miami, US) was used to calculate platelet count and MPV measurements.

Patients presenting as primigravidas, multigravidas and with previous abortions were included in our study. Women who were non-consenting and having, chronic hypertension, pre-gestational diabetes mellitus, previous hematological disorders or any sort of autoimmune disorders were excluded from our study.

The normal range for mean platelet volume was taken as 7-10.5 fl. The mean and standard deviation was calculated for age, gestational weeks, platelet counts, and mean platelet volume values, percentages and frequency was recorded , gravidity, parity, number of abortions. All the data was collected by the researcher himself.

Data was analyzed using the software SPSS v.23. One way ANOVA test was applied.

A p-value of <0.05 was considered significant.

Results

A total number of 200 patients were enrolled in this study, of which 94 patients were normal, 70 were mildly pre-eclamptic and 36 were severely pre-eclamptic. The mean age, gravidity, parity, no. of abortions and gestational weeks of the patients were 28.24±5.82 years, 2.89±1.25, 1.25±0.97, 0.65±0.86, and 29.35±4.77 weeks, respectively. (Table-1)

The platelet count of normal patients, in mildly pre-eclamptic and in severely pre-eclamptic was 263200.7±53918.6, 201546.49±36916.36 and 170379.61±34475.69, respectively. The difference was statistically significant, (p= 0.000). The mean platelet volume of normal patients, in mildly pre-eclamptic and in severely pre-eclamptic was 7.58±1.14, 8.44±1.42, and 9.36±1.12 FL, respectively. The difference was also statistically significant, (p=0.000). (Table-2)

Table-1
Demographic Characteristics

VARIABLE	MEAN + S.D
Age	28.24±5.82
Gravidity	2.89±1.25
Parity	1.25±0.97
No. of Abortions	0.65±0.86
Gestational weeks	29.35±4.77

Table-2
Outcome variable comparison

VARIABLE		MEAN + S.D	P Value
PLATELET COUNT	Normal	263200.7±53918.6	
	Mild pre-eclampsia	201546.49±36916.36	
	Severe pre-eclampsia	170379.61±34475.69	0.000
MEAN PLATELET VOLUME	Normal	7.58±1.14	
	Mild pre-eclampsia	8.44±1.42	
	Severe pre-eclampsia	9.36±1.12	0.000

Discussion

Platelet function and activity is measured by mean platelet volume. Thrombomegaly which is a risk factor can be diagnosed mean platelet volume. This specific platelet index has been reported to increase in many disorders such as renal artery stenosis, myocardial infarction, diabetes mellitus and pre-eclampsia. It is the endothelial damage that leads to activation of platelets and this leads to the formation of micro-thrombi and increased platelet turnover. As a compensatory response, bone marrow releases younger and relatively larger platelets into the circulation which leads to increase in mean platelet volume. In a normal pregnancy, platelet counts remains stable but mean platelet volume decrease till 30th week as the pregnancy progresses and starts to increase after 37th week of gestation.

Current study showed clearly that in the platelet count was low (201546.49±36916.36) in mildly pre-eclamptic patients and lower (170379.61±34475.69) in severely pre-eclamptic patients as compared to (263200.7±53918.6) in normal patients. Mean platelet volume was high (8.44±1.42 FL) in mildly pre-eclamptic patients and higher (9.36±1.12 FL) in severely pre-eclamptic patients as compared to (7.58±1.14 FL) in normal patients.

KUMRU P. et al. showed in their study -conducted in 2007- that the platelet count was 246659±72378 in normal pregnant women, 212000±105873 in mild pre-eclampsia and 161925±46066 in severe preeclampsia [12]. AlSheeha MA et al. showed in their study which was conducted in 2016 that the platelet count as well as platelet count to mean platelet volume ratio was significantly lower in patients suffering from pre-eclampsia as compared to normal pregnant patients [13]. They concluded that the platelet count as well as platelet count to mean platelet volume ratio were useful in predicting the risk of pre-eclampsia. For diagnosis of pre-eclampsia in high risk patients, this study suggested the cutoff values of platelet count and platelet count to mean platelet volume ratio to be $<248.010 \times 10^3/\mu L$ and 31.2 respectively.

In a study conducted in 2015, Doğan K. et al. concluded that decrease in platelet count, increase in mean platelet volume and especially a decrease in platelet count to mean platelet volume ratio was observed in response to increased platelet turnover in pre-eclampsia [14]. This suggested that these parameters can be really useful in predicting the risk of pre-eclampsia but these factors play no significant role in determining the severity of the condition. A 2013 study by Freitas LG et al. has revealed that platelet count is a reliable candidate for the prediction and diagnosis of pre-eclampsia [15]. It further showed that mean platelet volume was also considerably increased in severely pre-eclamptic patients as compared to normotensive pregnant and non-pregnant women.

Sultana R. et al. have presented that when, in a study group of 100 women with equal number of control and diagnosed cases of pre-eclampsia, mean platelet count was recorded and it was revealed that mean platelet count was significantly higher in diagnosed cases of pre-eclampsia as compared to controls [16]. A study by Järemo P. et al. has publicized that though the platelet distribution is normal in pregnancy, patients with pre-eclampsia and severe pre-eclampsia during pregnancy inclined to have larger mean platelets volume in contrast with controls [17]. A study by Ceyhan T. et al. was published in the year 2006 [18]. According to this study, when platelet count and mean platelet volume were calculated in 56 pre-eclamptic patients against 43 normal patients and a probability plot was constructed, there were no significant differences between both groups in terms of platelet count and mean platelet volume. This are contradictory results and warrants the performing of further studies.

Conclusion

Current study reveals that platelet count and mean platelet volume vary according to severity of pre-eclampsia. Platelet count decreases while mean platelet volume increases with increase in severity of pre-eclampsia. Subsequently, platelet count to mean platelet volume ratio also decreases with increasing severity. In short, these parameters can be helpful in prediction of the risk and severity of pre-eclampsia at a much lower cost. But, there is need to conduct further studies on larger populations to clearly define the cutoff values of these indices for different intensities of pre-eclampsia.

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