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Original Article

Evaluation of the value of the first and third trimester maternal mean platelet volume (MPV) for prediction of pre-eclampsia

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ABSTRACT

Introduction: Pre-eclampsia is one of the most serious complications of pregnancy and one of the major causes of maternal mortality. Thus its prediction is a matter for serious concern.

Objective: The purpose of the present study is to determine the value of mean platelet volume (MPV) measurement in the first and third trimesters of pregnancy for the prediction of pre-eclampsia.

Method: A prospective nested case–control study was performed on pregnant women who were at 9–12 weeks of pregnancy. In the first trimester and again in 26–28 weeks, MPV was calculated. All eligible women were then monitored to delivery and the MPV of women who were pre-eclamptic was compared with the MPV of normotensive women.

Results: Pre-eclamptic women were compared with 269 normotensive women. MPV at the first trimester of pre-eclamptic women was significantly higher than normotensive women (10.2 ± 1.06 fl VS 9.68 ± 1.09 fl, $P = 0.008$). Also, MPV at the third trimester of pregnancy of pre-eclamptic women was more than normotensives (10.16 ± 1.23 fl VS 9.62 ± 1.12 fl, $P = 0.009$).

Area under the curve in receiver operating characteristics (ROC) curve was calculated as 0.64 for the predictive value of MPV at the first and third trimesters of pregnancy, which showed a low value of this test for predicting of pre-eclampsia.

Conclusion: MPV at the first and third trimesters of pregnancy are higher in women who eventually would be pre-eclamptic, but has low predictive value and is not a good predictor of pre-eclampsia.

Introduction

Pre-eclampsia is a specific syndrome of pregnancy, which is diagnosed by elevated blood pressure, plus proteinurias that are papered after 20 weeks of pregnancy, and is one of the most serious complications of pregnancy and a major cause of maternal mortality and morbidity. It is also one of the most unknown complications during pregnancy, which, in spite of many studies, still pose many unanswered questions. Hypertensive disorders during pregnancy are seen in 5–11% of pregnancies [1,2]. This disorder is accompanied with reduced blood perfusion to different organs secondary to diffuse vasospasm and endothelial cell damage. Also, maternal systemic vascular resistance and platelet activity would increase during pre-eclampsia, which is terminated to reduced placental perfusion [3,4]. However, systemic endothelial dysfunction has a key role in pre-eclampsia.

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Hyper destruction of platelets may occur during pregnancy, which causes a reduced platelet life span [5]. Young platelets are larger than older ones. The mean platelet count reduces during normal pregnancy and MPV would increase specially from 28 to 31 weeks of gestation. This reduced platelet counts and increased MPV; continued throughout pregnancy [5–7]. At the same time, normal pregnancy is accompanied by increased platelet aggregation [6], and reduced platelet numbers in circulation with increasing gestational age [6]. In pre-eclamptic women or in the cases of intrauterine growth restriction (IUGR), reduced number of platelets has been reported [5,6,8]. Changes in platelet function are more complex. In normal pregnancies, a small increase in platelet aggregation is observed which is due to increased MPV [6,9,10]. Increased platelets size is reported in the cases of pre-eclampsia [6]. MPV has a non-linear correlation with platelet count and is a representative of platelet recycling. MPV increases with an increase in platelet destruction in peripheral circulation and decreases with failure in platelet production in the bone marrow. In fact higher MPV is a representative of increase in the growth of megacariocytes in bone marrow secondary to the stress of thrombocytopenia or low platelet count, which is terminated to the production of young large platelets. Studies have shown that MPV is higher in pre-eclamptic women than normotensive pregnant women [11,12].

Up to now, different biological and biochemical markers have been used for the prediction of pre-eclampsia and almost all have shown low sensitivity, and at the present time there is no reliable, simple and inexpensive screening test for pre-eclampsia [2]. A reliable screening test could help physicians identify the pregnant women who are at risk for pre-eclampsia sooner in order to perform more specific prenatal care. If MPV measurement can be proven as a reliable test for pre-eclampsia screening, regarding its accessibility and low price, it would be very useful.

Platelet activation has a significant role in the pathogenesis of pre-eclampsia which appeared with low platelet count, high MPV, and increased plasma concentration of the other platelet factors in pre-eclampsia [13]. Thrombocytopenia (if presents) occurs before the beginning of clinical pre-eclampsia, and an intensified platelet activation state occurs probably before the onset of pre-eclampsia. This might be used as a screening test for the prediction of pre-eclampsia.

Platelet volume is a marker of platelet age and indirectly may relate to the efficiency of the platelet (aggregation), which is easily calculated by MPV, through clinical hematologic analyzers using sodium citrate as an anticoagulant. MPV relates to platelet age and platelet efficiency which can be evaluated by platelet aggregation, thromboxane synthesis, beta-thromboglubin release, procaogulant function or adhesion molecule expression.

MPV increases in specific vascular risky states like diabetes mellitus, hypercholesterolemia, acute myocardial infarction, acute ischemic stroke and pre-eclampsia, but further studies are needed in order to judge its usefulness for the prediction of pre-eclampsia [14].

Platelet size is determined mainly in the bone marrow and during the megacariocytopoiesis period and would not change significantly later [15]. Special conditions, like endothelial dysfunction, obesity and factors such as cytokines and growth factors, cause larger and more reactive platelet production in the bone morrow. This phenomenon may have an important role in vascular disorders, and MPV may be used as a predictor of stroke, acute myocardial infarction and re-stenosis of coronary angioplasty. It increases in obesity, diabetes mellitus and the metabolic syndrome [15,16].

The purpose of the present study is to evaluate the value of MPV for predicting pre-eclampsia.

Materials and methods

A prospective nested case–control study was performed on pregnant women who had been referred to the prenatal clinic of Akbarabadi Teaching Hospital in Tehran, Iran, between March 2010 and 2011.

Inclusion criteria were: gestational age between 9 and 12 weeks (with a reliable LMP and ultrasound confirmation), singleton, and maternal age between 15 and 45 years old.

Exclusion criteria were, any known maternal systemic disorder (including chronic hypertension, diabetes mellitus, collagen vascular disorders, and ischemic heart disease and kidney disorders), using immunosuppressive drugs and anticoagulants, history of previous poor pregnancy outcomes like recurrent abortions, intrauterine fetal death (IUFD), pre-eclampsia, intrauterine growth restriction (IUGR) and smoking.

A written informed consent was obtained from all participants and they were fully informed about the study, and advised that there would be no extra expense for the women. Institutional review board approval (Iran University of Medical Sciences) and also Iran University of Medical Sciences ethics committee approval was given to the study.

Study was performed as a prospective nested case–control study. In the eligible women (523 women), a blood sample was obtained at 9–12 weeks of gestation for MPV measurement and repeated at 26–28 weeks of gestation at the beginning of the third trimester, [17] (in order to find that which of them can predict pre-eclampsia). All women were then monitored up to delivery. 35 women who were pre-eclamptic were compared with selected 269 normotensive women according to the MPV.

Pre-eclampsia was defined as blood pressure of $\geqslant$140/90 mmHg on two occasions, 6 h apart plus urine protein excretion of more than 300 mg in 24 h urine.

MPV is a representative of platelet function and activity and has non-linear relationship with platelet counts, its normal value is between 7.2 and 11.1 fl (femtoliter), and was measured using complete blood count analyzer (Sysmex, XE-5000).

The obtained data were then analyzed using SPSS16. Quantitative data were calculated as mean ± standard deviation and qualitative data were calculated as numbers and percentages. For comparing of quantitative data regarding their normal distribution, univariate analysis was used and for comparing the qualitative data the chi-square test was used.

Receiver operative characteristics (ROC) curve was used for the determination of prognostic value. *P* value of less