

ORIGINAL RESEARCH

Association of Mean Platelet Volume and Gestational Diabetes Mellitus

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ABSTRACT

Background: Gestational Diabetes Mellitus (GDM) is defined as any glucose intolerance that first occurs or is first diagnosed in pregnancy. GDM is long known to be associated with neonatal and maternal morbidity. Early screening and better diagnostic tools can help decrease chances of GDM. One of the most accessible and inexpensive inflammatory markers is platelet indices. Various studies show that indices like platelet count, mean platelet volume, plateletcrit, platelet to lymphocyte ratio have association with GDM occurrence but there is lack of such studies among the Indian population. This study aimed to investigate the association between mean platelet volume and the risk of GDM occurrence using maternal CBC sampling in the second trimester of pregnancy.

Materials and Methods: This cross-sectional study included 2 groups of 66 pregnant women with and without GDM. The women in each group were compared after the routine screening for GDM and CBC test at 24–28 weeks' gestation after being matched according to the inclusion criteria. All the statistical analysis were done using Epi info version 7.2.1.0 statistical software.

Results: The two groups were compared with respect to various sociodemographic factors I. e., age, parity, religion, literacy status where the resulting difference was statistically significant in case of their socioeconomic status where majority (50%) of GDM pregnancies belonged to Lower class compared to 51.1% of healthy pregnancies from lower middle class. The difference in values of mean platelet volume among the two groups was found to be statistically significant ($p < 0.001$). In the ROC, the area under the curve was 0.86 and with critical cut off value as 12.45fL, the sensitivity and specificity were 71.2% and 87.9% respectively.

Conclusion: Given the inflammatory nature of the disease, GDM and associated high levels of maternal and fetal morbidities, an adjunct to present screening techniques is needed. Our study infers that mean platelet volume is a highly specific indicator of GDM. These values can further be studied in first trimester of pregnancy which may further be helpful in earlier diagnosis of GDM.

Keywords: GDM, Platelet indices, Early screening in GDM, Mean Platelet Volume.

INTRODUCTION

GDM is defined as any glucose intolerance that first occurs or is first diagnosed in pregnancy.¹ GDM is one of the most common chronic diseases of pregnancies.¹ The worldwide estimated prevalence of GDM is 13.2%.² Most Indian studies estimated prevalence to be 9-22% varying with sociodemographic factors.³

GDM is long known to be associated with neonatal and maternal morbidity. Early screening and better diagnostic tools can help decrease chances of GDM associated preclampsia, polyhydramnios, fetal macrosomia, operative delivery, prenatal mortality.⁴ GDM has been a subject of research since many years and its effects on pregnancy have been well known. Despite of a high prevalence and available information, a universal consensus regarding the screening procedure is still lacking.¹ According to International Diabetes Federation guidelines, the diagnosis of GDM occurs when a glucose tolerance test performed at 24–28 weeks of pregnancy reveals a fasting blood glucose greater than 92mg/dL, glucose level 1 hour after ingesting 75 g of glucose of up to 180 mg/dL, or a glucose level 2 hours after ingesting 75 g of glucose greater than 153 mg/dL.⁵ In India however, the prevalence can be significantly higher and resources minimal, it is recommended to perform an OGTT based on DIPSI criterion at the first antenatal visit and later again at 24-28 weeks. A high level of placental lactogen hormone is associated with increased lipolysis, and the release of free fatty acids may increase insulin resistance especially in the second trimester.¹

GDM is known to have background chronic inflammation which implies that the inflammatory changes may be present even before clinically demonstrable glucose intolerance happens.⁶ This may point towards the fact that an OGTT might miss the cases if done very early in pregnancy whereas markers of inflammation might have already been present.

One of the most accessible and inexpensive inflammatory markers is platelet indices. These are a part of a routine CBC test.⁷ Various studies show that indices like platelet count, mean platelet volume, plateletcrit, platelet to lymphocyte ratio have association with GDM occurrence but there is lack of such studies among the Indian population.⁷ This study aimed to investigate the association between mean platelet volume and the risk of GDM occurrence using maternal CBC sampling in the second trimester of pregnancy.

MATERIALS AND METHODS

This was a cross-sectional study conducted from April 2021 to July 2021 in ANC OPD of Sawai Man Singh Medical College, Jaipur, a tertiary health care centre. After applying the inclusion and exclusion criteria the participants were divided into two groups. For the purpose of calculation of sample size, an absolute error of 10% was taken into account. Taking confidence interval at 95% and power of the study at 80%, sample was calculated using the formula of difference between the two means which comes out to be 60 in each group. Taking attrition rate to be 10%, 66 was taken as the minimum sample needed in each group. Each participant was explained about the nature of the study and written, and informed consent was taken. A predesigned proforma was filled for each of them consisting of previous medical and obstetric history and various socio demographic factors.

The inclusion criteria for study were: Women consenting to be a part of the study, singleton, spontaneous pregnancies at 24-28 weeks of gestation coming to ANC OPD. Women with previous history of GDM/overt DM, family history of DM, substance use, medical and infectious diseases in current pregnancy were excluded. Women participating in another study were also excluded.

All the participants were subjected to venous blood sampling from the antecubital vein. A 5 ml of blood sample was taken and put in an EDTA vial and processed within 60 minutes. CBC report was obtained, and mean platelet volumes charted.

An 8 hour fasting blood sample was taken from all the participants and an oral glucose tolerance test was done using 75gm anhydrous glucose as the load. Blood samples for sugar levels were taken after 1 hour and 2 hours. Participants were categorized as GDM or healthy pregnancies according to IADPSG criteria. A fasting blood sugar level of 92mg% or more and/or 1-hour post OGTT 180mg% or more and/or 2 hour post OGTT 153mg% or more was considered GDM.

Participant detail and lab analyses report were documented in a detailed master chart.

Categorical variables were summarised as frequency and percentage. They were analysed using chi-square test. Continuous variables were summarised as mean and standard deviation. They were analysed using t test (for 2 groups). ROC curve analysis was done to determine ability of mean platelet volume to diagnose GDM. Area under the curve was calculated along with its 95% confidence interval. Critical cut-off value was calculated using youden index and using this critical cut off value, sensitivity and specificity were calculated. A p value<0.05 was taken as statistically significant. All the statistical analyses were done using Epi info version 7.2.1.0 statistical software.

Table 1: Distribution of participants according to age

Age group (years)	GDM		Healthy pregnancies		Total	
	N	%	N	%	N	%
<20	0	0	6	9.1	6	4.5
20-24	5	7.6	31	47	36	27.3
25-29	35	53	26	39.4	61	46.2
30-34	21	31.8	3	4.5	24	18.2
35-40	5	7.6	0	0	5	3.8
Total	66	100	66	100	132	100
Mean ± SD	29.11 ± 3.57		24.18 ± 3.44		26.64 ± 4.28	
Chi-square = 44.606 with 4 degrees of freedom; P < 0.001 (S)						

Table 2: Distribution of participants according to parity

Parity	GDM		Health pregnancies		Total	
	N	%	N	%	N	%
0	7	10.6	24	36.4	31	23.5
1	23	34.8	30	45.5	53	40.2
2	31	47	9	13.6	40	30.3
3	4	6.1	2	3	6	4.5
4	1	1.5	1	1.5	2	1.5
Total	66	100	66	100	132	100
Chi-square = 23.014 with 4 degrees of freedom; P < 0.001 (S)						

Table 3: Distribution of participants according to religion

Religion	GDM		Healthy pregnancies		Total	
	N	%	N	%	N	%
Hindu	37	56.1	40	60.6	77	58.3
Muslim	29	43.9	26	39.4	55	41.7
Total	66	100	66	100	132	100
Chi-square = 0.125 with 1 degree of freedom; P = 0.724						

Table 4: Distribution of participants according to literacy status

Literacy status	GDM		Healthy pregnancies		Total	
	N	%	N	%	N	%

Illiterate	38	57.6	30	45.5	68	51.5
Literate	28	42.4	36	54.5	64	48.5
Total	66	100	66	100	132	100
Chi-square = 1.486 with 1 degree of freedom; P = 0.223						

Table 5: Distribution of participants according to socioeconomic status

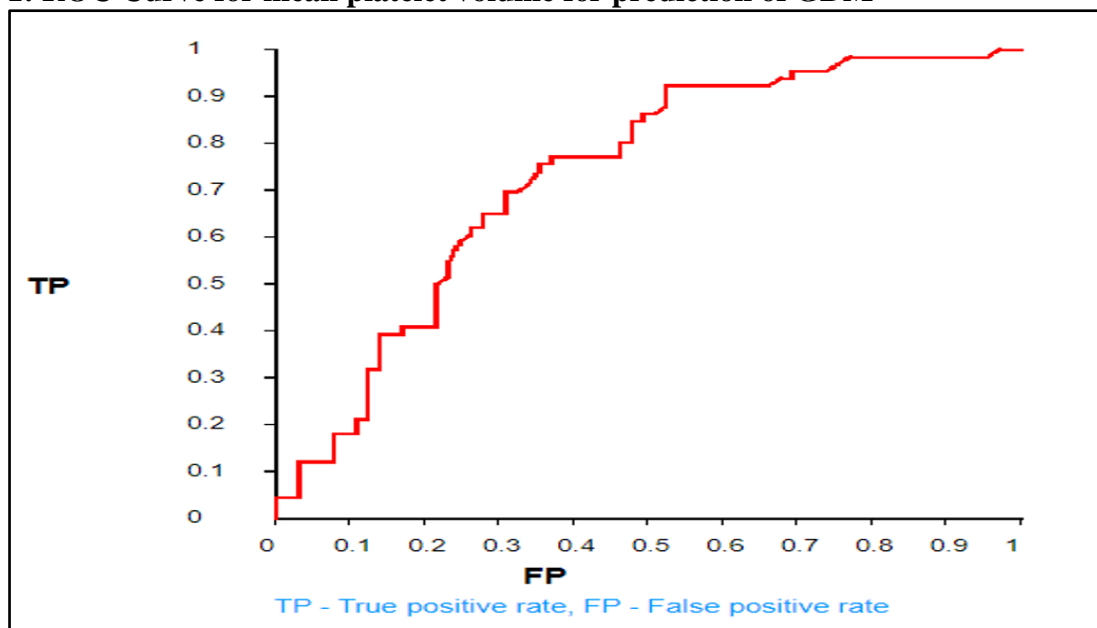
Socio economic status	GDM		Healthy pregnancies		Total	
	N	%	N	%	N	%
Lower	33	50	15	22.7	48	36.4
Lower Middle	20	30.3	34	51.5	54	40.9
Middle	8	12.1	15	22.7	23	17.4
Middle Upper	4	6.1	0	0	4	3
Upper	1	1.5	2	3	3	2.3
Total	66	100	66	100	132	100
Chi-square = 17.527 with 6 degrees of freedom; P = 0.008 (S)						

Table 6: Comparison of mean platelet volume (fL) in both groups

Group	N	platelet volume (Mean \pm SD)	P value
GDM	66	13 \pm 1.19	<0.001 (S)
Health pregnancies	66	11.1 \pm 1.23	

Table 7: ROC Curve for mean platelet volume for precision of GDM

AUC (95% CI)	0.860 (0.798 – 0.922)
P value	<0.001 (S)
Critical cutoff	12.45fl
Sensitivity	71.2%
Specificity	87.9%

Fig 1: ROC Curve for mean platelet volume for prediction of GDM

RESULTS

The two groups were compared with respect to various sociodemographic factors I.e., age, parity, religion, literacy status where the resulting difference was statistically insignificant. (Table 1, 2, 3, 4) The difference was however statistically significant in case of their socioeconomic status where majority (50%) of GDM pregnancies belonged to Lower class compared to 51.1% of healthy pregnancies from lower middle class (Table 5).

The difference in values of mean platelet volume among the two groups was found to be statistically significant ($p < 0.001$) (Table 6). In the ROC the area under the curve was 0.86 and with critical cut off value as 12.45fL, the sensitivity and specificity were 71.2% and 87.9% respectively (Figure 1) (Table 7).

DISCUSSION

As diabetes is a chronic inflammatory state, the pathophysiologic process occurs weeks to months before the diagnosis and factors associated with the disease can be present before a diagnosis is made.⁶ Platelets are thus predominantly in a state of overactivation in women with GDM.⁷ Multiple studies have examined circulating platelet activity in GDM pregnancies and found that platelet count, platelet to lymphocyte ratio (PLR) and mean platelet volume (MPV), a measure of platelet function and a marker of activation potential, are significantly higher in GDM pregnancies.⁷

Our study results suggest that Mean platelet volume values have a very good association with occurrence of GDM in the second trimester of pregnancy. A higher MPV, and larger platelet size, increases platelet aggregation and thromboxane A₂ production, stimulating further thrombotic events and contributing to the vascular complications evident in GDM.⁸ The predominant hypothesis remains that GDM pathology is characterised by abnormal platelet hyperactivity and that platelet indices may present a predictive tool in GDM diagnosis.⁸ Priyadarshini Pantham et al, in 2015 observed in their study that inflammation was observed in pregnancies complicated by obesity and GDM, and may play a central role in determining the fetal environment in these pregnancies.⁹ Systematic review and meta-analysis was done in 2018 by Zhou and coworkers where nineteen studies comprising 1361 GDM patients and 1911 normal pregnant women were included.¹⁰ Similar to our results, MPV was increased in GDM patients when compared with healthy pregnant women. Bozkurt et al. (2016) studied the platelet count and mean platelet volume (MPV) values of pregnancies diagnosed with gestational diabetes and those of healthy pregnancies.¹¹ 100 healthy pregnancies and 100 pregnancies with gestational diabetes were studied and the MPV of the gestational diabetes group (9.4 +/- 1.6 fl) was evaluated to be significantly higher than the MPV of the healthy pregnancy group (8.3 +/- 1.1 fl). Additionally, when linear regression analysis was performed an inverse relationship was observed between platelet number and MPV. However, Erdoğan et al. in 2014 found no association between MPV and GDM. The reason for this result was the low number of samples compared to the other studies.¹²

CONCLUSION

Given the inflammatory nature of the disease, GDM and associated high levels of maternal and fetal morbidities, an adjunct to present screening techniques is needed. Platelet indices are one of the most cost-effective tests available as the results are a part of routine CBC performed at most health centres. Our study infers that mean platelet volume is a highly specific indicator of GDM.

This study is in concordance with various other studies that were performed over the last two decades to conclude that the mean platelet volume can prove to be a notable indicator of GDM in the future. These values can further be studied in first trimester of pregnancy which may further be helpful in earlier diagnosis of GDM.

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