Mean Platelet Volume as a Predictive Marker for GDM

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Abstract

Background: Gestational Diabetes Mellitus (GDM) is defined as first onset of any glucose intolerance diagnosed in pregnancy and certain proportion has risk of developing type 2 diabetes later in life, but risk of type 1 is also increased. Screening at the earliest and enhanced diagnostic tools can help reduce burden of GDM and further progression as it is majorly a lifestyle disease. One of the easiest and cost-effective inflammatory markers are thrombocyte indices.

Objective: To determine the potential value of MPV, an inexpensive and easy tool obtained from routine complete blood picture used to study morphology of platelet and whether it can be an indicator in prediction of GDM.

Methods: Hospital based comparative study was done on 100 antenatal women attending OPD during first trimester. Case group includes women with recently diagnosed GDM as per guidelines of American diabetes Association by one-step 2-hour 75g OGTT and the cut off values were considered as per IADPSG. MPV is assessed amongst cases and controls and its association was studied in both groups.

Results: The present study observed that MPV values of the GDM patients were significantly higher than those compared to normal pregnancies. The current investigation reveals that MPV values in GDM patients significantly exceed those observed in normal pregnancies. Specifically, the median MPV in the GDM group is 8.6 (IQR: 6.9-11.2), while in the non-GDM group, it is 7.4 (IQR: 4.8-10.4). The Mann-Whitney U test yielded a statistic of 905, with a corresponding p-value of 0.0175, which falls below the significance threshold of 0.05. Hence, there exists a statistically significant disparity in MPV between the groups.

Conclusion: GDM is found to have underlying chronic inflammatory background and varied insulin resistance which states that these parameters may exist even before clinically diagnosable glucose intolerance occurs. This may direct that GTT might not detect GDM if done early in pregnancy, but inflammatory markers might diagnose as they have already been existing. One such economical marker is the MPV as a part of routine CBC.
Introduction

Gestational diabetes mellitus (GDM) is defined as the first onset of carbohydrate intolerance in pregnancy and is prevalent in 4-25% of all pregnancies [1]. Although glucose intolerance may become normal in most GDM women post-delivery, however a certain proportion of them are at significant risk for progression to type 2 Diabetes Mellitus (T2DM), CVD, NCD burden [4]. Thus, early diagnosis and prompt treatment are vital to prevent complications [2]. Deviation in platelet morphology and function that includes decrease in nitric oxide synthase activity and increase in peroxynitrite production has been reported in diabetes mellitus [3]. GDM women generally have varied levels of insulin resistance, a chronic low-grade inflammation which potentiates vascular injury, dysfunction and subsequent thrombocyte activation. Thus, the severity of both platelet activation and GDM may be correlated. MPV is a valuable parameter that could assess platelet morphology and function. Increase in MPV is a direct indicator of thrombocyte synthesis and activation [5] and causes increased platelet aggregation, release of thromboxane A2 and β thrombomodulin, and also raise in receptors of adhesion molecules glycoprotein IIb/IIIa and glycoprotein Ib [6]. Raised values of MPV may trigger vein occlusion and decrease in the prostacyclin, thus leading to vasoconstriction [7-8]. Such changes are associated with increased risk of cardiovascular disease. The aim of this study is to determine the potential value of MPV, an inexpensive and easy tool obtained from routine complete blood picture used to study morphology of platelet and whether it can be an indicator in prediction of GDM. This study compares the mean platelet volume in gestational diabetes and non GDM pregnant women and to investigate whether there is a statistically significant difference between both the groups.

Methods

The present work is a hospital based comparative study that took place at the Department of Obstetrics and Gynecology in Apollo BGS Hospital. This study was conducted on 100 antenatal women during their regular ANC visits to OPD during the period of September 2020 to September 2021.

Inclusion criteria

Women diagnosed with gestational diabetes mellitus recently as cases, Women with normal GTT as controls.

Exclusion criteria

Subjects with hypertension, collagen tissue disorders, Chronic inflammatory disease or autoimmune disease, Acute or chronic infection, Other known malignancy, Heart failure, Myeloproliferative disorders, Hepatic or renal disorders, Taking anticoagulants.

Sample size: 50 cases and 50 controls were used.
\[ N = \frac{2 \times M \times (\sigma)^2}{(d)^2} \]

Primary outcome variable = MPV, At \( \alpha = 5\% \), \( \beta=5\% \), \( M=13 \), \( n=45 \) per group

Usually, \( n \) should be more than calculated. So, sample size is fixed as 50 in each group. Women in this study were categorized into cases and controls. Women with recent diagnosis of gestational diabetes mellitus as per one step 2-hour 75g (ADA) GTT were considered as cases. The values were considered as per IADPSG. Control group includes women with a normal Glucose tolerance test.

After obtaining ethical committee clearance, written informed consent was taken from patients, and was included in the study. Demographic details including age, socioeconomic status, residence, educational status was obtained by a standard questionnaire.

Obstetric details like gravida, para, previous history of miscarriage, height, weight of the mother, and comorbidities were noted. Women who underwent routine screening tests like CBC and GTT 75grams test were divided into control and cases as per variation in the GTT values. Strategy for screening and diagnosis of hyperglycemic disorders in pregnancy in our hospital is by IADPSG CRITERIA (ONE STEP STRATEGY) for first and subsequent trimester at 24-28 weeks.

For IADPSG criteria an OGTT is done in the morning after overnight fasting state of \( \geq 8 \) hours, using ingestion of 75g of glucose dissolved in 300ml water at 24 to 28 weeks with plasma glucose measurement fasting, 1-hour and 2-hour and the diagnosis of gestational diabetes is made when one or more values of plasma glucose is same or more than the values below.

**Two hour 75 – Gram Oral Glucose Tolerance Test**

Fasting - \( \geq 92 \) mg/dL (5.1 mmol/L)

OR

One – Hour - \( \geq 180 \) mg/dL (10.0 mmol/L)

OR

Two – Hour - \( \geq 153 \) mg/dL (8.5 mmol/L)

To overcome the platelet swelling due to ethylene diamine tetra acetate (EDTA), blood sampling was done within half an hour of collection and analyzed. Complete blood count (CBC) parameters were measured by an automated blood counter. Followed by which MPV is assessed amongst cases and controls and its association was studied in both groups.
Results

The majority of the patients in GDM group were 19-24 years i.e., 36% (18), 40% (20) belonged to 25-30 years and 24% (12) belonged to 31-35 years. In non-GDM group 28% (14) belongs to 19-24 years, 42% (21) belongs to 25-30 years and 30% (15) belongs to 31-35 years. And overall, 32% (32) belongs to 19-24 years, 41% (41) were belongs to 25-30 years and 27% (27) belongs to 31-35 years [Table 1].

Table 1: Age distribution among the groups in the study sample

<table>
<thead>
<tr>
<th>Age Group: n (%)</th>
<th>Overall N=100</th>
<th>GDM n=50</th>
<th>No-GDM n=50</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-24 years</td>
<td>32 (32.0%)</td>
<td>18 (36.0%)</td>
<td>14 (28.0%)</td>
<td>0.665</td>
</tr>
<tr>
<td>25-30 years</td>
<td>41 (41.0%)</td>
<td>20 (40.0%)</td>
<td>21 (42.0%)</td>
<td></td>
</tr>
<tr>
<td>31-35 years</td>
<td>27 (27.0%)</td>
<td>12 (24.0%)</td>
<td>15 (30.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Most of the patients in GDM group are multi gravida i.e., 92% (46), 8% (4) were primi gravida. In non-GDM group 58% (29) are multi gravida, 42% (21) were primi gravida. And overall, 75% (75) are multi gravida, 25% (25) were primi gravida [Figure 1].

Figure 1: Distribution of gravida among the groups in the study sample

The majority of the patients in GDM group were overweight i.e., 44% (22), 34% (17) were obese and 22% (11) were healthy weight. In non-GDM group 62% (31) were healthy weight, 34% (17) were overweight, and 2% (1) were obese.
and underweight. And overall, 42% (42) were healthy weight, 39% (39) were overweight, 18% (18) were obese and 1% (1) were underweight [Figure 2].

![BMI Status](image)

Figure 2: Distribution of BMI among the groups in the study sample

<table>
<thead>
<tr>
<th>MPV: n (%)</th>
<th>Overall</th>
<th>GDM</th>
<th>No-GDM</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of subjects</td>
<td>N=100</td>
<td>n=50</td>
<td>n=50</td>
<td></td>
</tr>
<tr>
<td>Low (&lt;7.5)</td>
<td>43 (43.0%)</td>
<td>17 (34.0%)</td>
<td>26 (52.0%)</td>
<td>0.0935</td>
</tr>
<tr>
<td>Normal (7.5-12.0)</td>
<td>51 (51.0%)</td>
<td>28 (56.0%)</td>
<td>23 (46.0%)</td>
<td></td>
</tr>
<tr>
<td>High (&gt;12.0)</td>
<td>6 (6.0%)</td>
<td>5 (10.0%)</td>
<td>1 (2.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Distribution of MPV among the groups in the study sample

In the study sample 43% (43) were having MPV < 7.5, 6% (6) were having MPV > 12.0 and 51% (51) were having normal level i.e., 7.5-12.0. Among GDM group 34% (17) were having MPV < 7.5, 10% (5) were having MPV > 12.0 and 56% (28) were having normal level i.e., 7.5-12 [Table 2]. Among non-GDM group 52% (26) were having MPV < 7.5, 2% (1) were having MPV > 12.0 and 46% (23) were having normal level i.e., 7.5-12 [Figure 3].
The median platelet volume (MPV) in the GDM group is 8.6 with an interquartile range (IQR) of 6.9 to 11.2, while in the non-GDM group, the median MPV is 7.4 with an IQR of 4.8 to 10.4. The p-value obtained from statistical analysis is 0.0175, which is less than the significance level of 0.05 [Table 3]. Therefore, there exists a statistically significant difference in MPV between the subjects of GDM and No-GDM groups.

### Figure 3: Comparison of MPV among the groups

### Table 3: Comparison of MPV among the groups

<table>
<thead>
<tr>
<th>MPV</th>
<th>Overall</th>
<th>GDM</th>
<th>No-GDM</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>N=100</td>
<td>n=50</td>
<td>n=50</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td></td>
<td>8.2 ± 2.7</td>
<td>8.8 ± 2.4</td>
<td>7.6 ± 2.8</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td></td>
<td>8.1 (6.0, 10.7)</td>
<td>8.6 (6.9, 11.2)</td>
<td>7.4 (4.8, 10.4)</td>
</tr>
</tbody>
</table>

The median platelet volume (MPV) in the GDM group is 8.6 with an interquartile range (IQR) of 6.9 to 11.2, while in the non-GDM group, the median MPV is 7.4 with an IQR of 4.8 to 10.4. The p-value obtained from statistical analysis is 0.0175, which is less than the significance level of 0.05 [Table 3]. Therefore, there exists a statistically significant difference in MPV between the subjects of GDM and No-GDM groups.

### Figure 4: Distribution of MPV

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The distribution of MPV shown between the subjects of GDM and No-GDM groups [Figure 4]. Correlation of clinical parameters with MPV presented in table 4.

Table 4: Correlation of clinical parameters with MPV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Correlation Coefficient</th>
<th>p-value</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.899</td>
<td>&lt;0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>HbA1c</td>
<td>0.896</td>
<td>&lt;0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>FBS</td>
<td>0.416</td>
<td>&lt;0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>S1</td>
<td>0.324</td>
<td>0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>S2</td>
<td>0.249</td>
<td>0.012*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>GDM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.924</td>
<td>&lt;0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>HbA1c</td>
<td>0.834</td>
<td>&lt;0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>FBS</td>
<td>0.564</td>
<td>&lt;0.001*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>S1</td>
<td>0.373</td>
<td>0.008*</td>
<td>Positive Correlation</td>
</tr>
<tr>
<td>S2</td>
<td>0.264</td>
<td>0.064</td>
<td>Positive Correlation</td>
</tr>
</tbody>
</table>

Discussion

Complete blood count parameters including platelet indices cannot predict GDM according to our study results. But there are many studies on this subject in literature. Study outcomes are different and controversial.

Keziban Dogan, et al did a retrospective case control study on a total of 202 pregnant women including 78 pregnant women with GDM (38.6%) and 124 healthy pregnant women (61.4%; the control group) to determine whether or not MPV as a predictor for GDM and concluded that if blood samples are evaluated under healthy conditions (rapid collection, transfer and studying) blood count parameters would not be useful for predicting the diagnosis of GDM [9].

Sayed M. Abel-Rahman et al studied Mean platelet volume as a risk factor in pregnant diabetic women in 2012. A 50 g oral glucose load (OGL) was administered to all participants (400 pregnant women), and routine hematologic parameters and MPV were studied at 24–28 gestational weeks using a Beckman /Coulter MAXM Hematology Analyzer. When a plasma glucose level of at least 140 mg/dl was measured after administering OGL, a 100 g 3-h oral glucose tolerance test was performed. Of these women, 296 (74%) had normal oral glucose tolerance, 48 (12%) had GIGT, and 65 (14%) had GDM. The mean platelet counts were higher in the normal OGL group than in the GIGT group, and higher in the GIGT group than in the GDM group, with no statistically significant differences among the
three groups. However, concluded that MPV was significantly higher in the GDM group than in the normal glucose level group (P<0.05). Also, women with high MPV values had lower platelet counts [10].

Mahta Abbasi Fashami, et al conducted case-control study in 2020 which included 2 groups of 110 pregnant women with and without GDM to determine if there is an association between platelet and blood inflammatory indices and the risk of gestational diabetes mellitus. The women in each group were compared after the routine screening for GDM and after the CBC test at 24–28 weeks’ gestation after being matched according to the inclusion criteria and concluded that increasing platelet and inflammatory indices on the CBC test in the second trimester of pregnancy seemed to be associated with the probability of GDM occurrence [11].

The present study observed that MPV values of the GDM patients were significantly higher than those compared to normal pregnancies. The median platelet volume (MPV) in the GDM group is 8.6 with an interquartile range (IQR) of 6.9 to 11.2, while in the non-GDM group, the median MPV is 7.4 with an IQR of 4.8 to 10.4. The p-value obtained from statistical analysis is 0.0175, which is less than the significance level of 0.05. Therefore, there exists a statistically significant difference in MPV between the subjects of GDM and No-GDM groups.

In our study we determined HbA1c as a marker of glucose control in newly diagnosed GDM women and compared it with that of normal pregnancies. HbA1c% was found to be higher in the group of GDM than normal controls. Our results also showed that the MPV values were positively correlated with the HbA1c levels in the GDM cases.

Previous studies found that MPV of diabetic patients was positively correlated with blood glucose and HbA1c levels. We also found a relationship between the MPV and HbA1c values in the controls group. This positive correlation shows the association of increased platelets activation in GDM.

**Conclusion**

Due to the chronic inflammatory state of GDM and its attribution to maternal and fetal morbidity, more easily available addition to current screening methods is acceptable. Platelet indices are the most cost-effective as they are available as a part of routine CBC performed at most health care institutions. After utmost comprehensive analysis, we would like to conclude from our study that MPV is a sensitive and economical parameter to predict GDM.

This study is almost in par with the other research that concluded that the mean platelet volume can prove to be a remarkable indicator of GDM. We conclude that more studies are needed to establish the role of MPV in predicting GDM in the first trimester or as early as possible during pregnancy.

**Ethical Approval:** Nil

**Conflict of Interest:** Nil

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Financial Disclosure: None

References


