Original Research Article

Evaluating Role of Mean Platelet Volume as a Measure of Glycemic Control in Type 2 Diabetes Mellitus Patients

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Abstract

Background: Diabetes mellitus (DM) has become a worldwide epidemic. Platelet indices can be used to interpret the effects of hyperglycemia on platelet function (mean platelet volume-MPV, platelet distribution width and plateletcrit). These parameters are also valuable in determining the aetiology of DM as well as the risk of disease development. The mean platelet volume (MPV) is a measurement of platelet size and activity on average. Larger platelets are younger and more active.**Aims and Objectives:** To study the mean platelet volume to measure glycemic control in type 2 diabetes mellitus (T2DM).**Materials and Methods:** Two hundred subjects were studied after dividing them into Cases (n=100; subjects with T2DM) and Control (n=100 subjects without T2DM) at the Department of Medicine, Netaji Subhash Chandra Bose Medical College, and Hospital, Jabalpur (MP) from January 2018 to August 2019. Complete blood counts, random blood sugar (RBS), fasting blood sugar (FBS) and glycated hemoglobin (HbA1c), was estimated and recorded. People with diabetes with good glycemic control (patients with HbA1c<7%) called Group A and diabetic patients with poor glycemic control (HbA1c≥7%) called Group B. The MPV in each group was compared. MPV, FBS, and post prandial blood sugar (PPBS) were compared between cases and control. **Results:** Age and gender distribution were similar between both the groups (p>0.05). A strong positive correlation between HbA1c levels and MPV levels (r= 0.65; p<0.0001). For every 1% increase in HbA1c level, there is a 2.28 fl increase in MPV among the study subjects. A positive correlation was obtained between RBS levels and MPV levels (r=0.42, p< 0.0001). For every 100mg/dl increase in RBS, there is a 2.96 fl increase in MPV among the study subjects. **Conclusion:** MPV was greater in patients with poor glycemic control compared to those with good glycemic control. Hence, MPV can be used as a simple measure to assess the glycemic control in T2DM patients.

Keywords: mean platelet volume, diabetes mellitus, type 2 diabetes, glycemic control

Introduction

Diabetes mellitus (DM) and pre-diabetes have recently increased dramatically in India[1]. Studies indicate that inflammation plays an important role in the development of type 2 diabetes mellitus (T2DM)[2]. Systemic sub-clinical inflammation has been implicated in the development of type 2 diabetes[3].Inflammatory biomarkers, such as white cell counts, C-reactive protein, tumor necrosis factor-α, and interleukin- 6, were showed to be correlated with prevalent and incident diabetes[4].Studies showed that DM cases had increased platelet activity[5]. A meta-analysis that included 30 case-control and cross-sectional studies found that mean platelet volume (MPV) was significantly higher in T2DM cases than study participants without DM[6].MPV ranges between 7.5 and 12.0 fl, whereas large platelets should amount to 0.2-5.0% of the whole platelet population. MPV is inversely proportional to the platelet count in physiological conditions, which is associated with hemostasis maintenance and preservation of constant platelet mass[7].Although the underlying mechanism of higher MPV in diabetic subjects is incompletely understood, it has been suggested that increased MPV in diabetes may be due to osmotic swelling resulting from hyperglycemia[8]. Hence in the present study, we tiered to evaluate the role of mean platelet volume as a measure of glycemic control in T2DM.

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Materials and Methods

The present study was carried out in the Department of Medicine, Netaji Subhash Chandra Bose Medical College & Hospital, Jabalpur (MP), from January 2018 to August 2019. Two hundred subjects were enrolled and divided into Cases (n=100; subjects with T2DM) and Control (n=100, subjects without T2DM).

All the OPD / IPD patients aged between 14 to 80 years with diabetes or newly diagnosed with diabetes mellitus were included; for control, non-diabetic individuals were included.

Diabetes patients on antiplatelet drugs such as aspirin and clopidogrel, subjects with any diagnosed malignancy, infections affecting platelets, subjects with the primary liver and kidney, disease of bone marrow, and reticuloendothelial system, liver failure, and anemia were excluded.

Complete blood counts (CBC), random blood sugar, fasting blood sugar, glycated hemoglobin (HbA1c) were estimated and recorded in pre-approved proforma. Institutional Ethical Committee approval was obtained and written informed consent was obtained from all the patients before starting the study.

With all aseptic precaution, 6 ml blood was obtained from the antecubital vein, 2 ml for CBC in EDTA vial, and 4 ml in a non-EDTA vial for RBS, FLP, RFT, and FBS. The automated analyzer measured various platelet indices. Mean platelet volume was estimated and correlated with blood sugar level.

Venous samples were collected after 12 hours of overnight fasting at 8:30 am for MPV, HbA1c and FBS. PPBS was sent after one and a half to 2-hour present after a meal. High-Performance Liquid Chromatography measured HbA1c. Measurement of MPV was done using an automatic blood counter (Beckman Coulter Act5Diff). Plasma glucose estimation (FBS and PPBS) was carried out by the glucose oxidase method in the autoanalyzer.

After baseline evaluation, the patients were divided into two groups based on HbA1C levels. People with diabetes with good glycemic control (patients with HbA1c<7%) are called Group A, and diabetic patients with poor glycemic control (HbA1c≥7%) are called Group B. The MPV in each group was compared. MPV, FBS, and PPBS were compared between cases and control.

All the information was produced in the master chart. Data analysis was done with the help of a computer using the software IBM-SPSS version 22 for windows; percentage, mean, standard deviation, and P-value was calculated. A p-value of <0.05 was taken as significant.

Results

The majority of the diabetes patients had an age between 41–70 years of age. Participants of the control group were significantly younger than the case group (P=0.0056). The female and male ratio in the case and control group was 50:50 and 43:57 respectively (P=0.321).

Table 1: Comparing participants characteristics concerning glycemic control

Parameters	Glycemic control		P-value
	Good	Poor	
Age, mean ± SD	53.00±10.04	54.77±12.05	0.708
FBS, mg/dL	157±64.69	227±113.48	0.0006
PPBS, mg/dL	195±52.85	224.64±80.87	0.05
MPV, fl	9.11±0.68	11.05±1.15	<0.0001

The majority in good glycemic control group belonged to 41-50 years age class interval (30%), followed by 51-70 years with a mean age of 53.9±10.04 years and majority in poor glycemic control group belonged to 61-70 years of age class interval (26.70%) with a mean age of 54.77±12.05 years (P=0.708). The majority in the good control group were females (52.50%), whereas the majority in the poor glycemic control group were males (51.70%).

Majority in good glycemic control group belonged to >140 mg/dl FBS class interval (57.50%) with a mean FBS of 157±64.69 mg/dl and majority in poor glycemic control group also belonged to > 140 mg/dl FBS class interval (78.30%) with a mean FBS of 277±113.48 mg/dl (P=0.0006). The majority in the good glycemic control group belonged to 151-200 mg/dl PPBS class interval (40.00%) with a mean PPBS of 195.97±52.87 mg/dl, and the majority in the poor glycemic control group also belonged to 151-200 mg/dl PPBS class interval (31.70%) with a mean PPBS of 224.64±80.87 mg/dl. This significance is exhibited by the increased mean PPBS levels in the poor glycemic control group compared to the good glycemic control group (p=0.05).

The majority in the good glycemic control group belonged to 8.00-10.00 fL MPV class interval (87.50%) with a mean MPV of 9.11 fL, and the majority in the poor glycemic control group belonged to >10.01 fL MPV class interval (81.70%) with a mean MPV of 11.05 fL. This significance is exhibited by the increased mean MPV levels in the poor glycemic control group compared to the good glycemic control group (P < 0.0001)

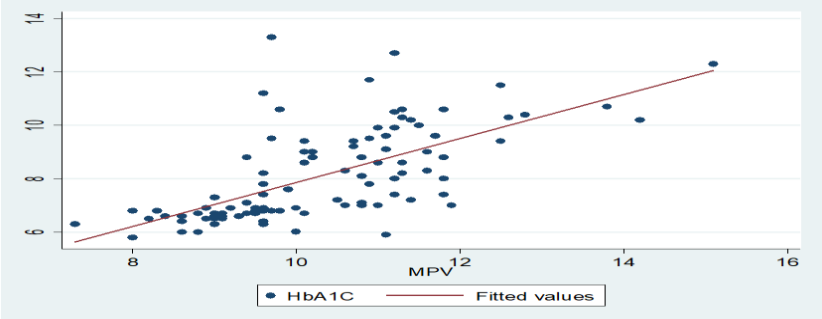

Fig 1: Showing the Pearson correlation between HbA1c levels and MPV

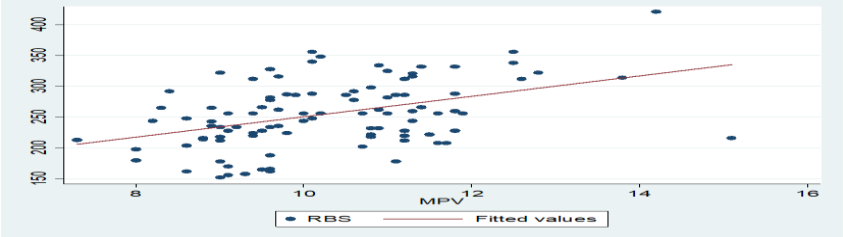

Fig 2: Showing the Pearson correlation between RBS levels and MPV levels

Discussion

Diabetes mellitus is one of the most significant global health emergencies of the 21st century. MPV is a determinant of platelet

function and platelet size. It reflects changes in either platelet stimulation or the rate of platelet production. Large platelets are hemostatically more active and a risk factor for vascular complications. In the present study, we have selected 100 patients who have fulfilled the criteria for diabetes mellitus according to the international diabetes federation and 100 control.

In the present study, the mean age of cases and control was 54.42±11.25 and 50.02±10.95 years, respectively. A recent study by Jaman et al. 2017 studied 87 T2DM patients after dividing into Group A (n=41, HbA1c ≤ 6.5 – 6.9%) and Group B (n=46, HbA1c ≥ 7.0%) reported mean age of 50±12.60 years where no significant difference was obtained age distribution between the groups (p=0.265)[9].In the present study female and male ratio in the case and control groups was 50:50 and 43:57, respectively. The distribution was insignificant with male preponderance. Dayal et al. studied 211 subjects. Of them, 105 had diabetes, and 106 were healthy individuals. They reported that among people with diabetes, 55 were male and 50 females, whereas, among the healthy individuals, 49 were males and 47 females[10].Thus noting male preponderance similar to the present study. In the present study, 40% of diabetic cases have HbA1c <7, and 60 % of diabetic cases have HbA1 ≥7. In agreement to present study, a study from Bhopal by Dubey et al. enrolled 100 and reported that 10 % of patients had HbA1c < 7% while 90% pt had HbA1c≥7%[11]

A study carried out by Pradhan et al. including 70 previously diagnosed diabetic and 130 non-diabetic patients reported that mean FBS in Group A (HbA1c <6.5%) and Group B (HbA1c ≥6.5%) was 104.76±21.37mg/dl and 148.17±54.55mg/dl respectively[12] and study done by Dubey et al. reported mean FBS of 142.55±5.31mg/dl in HbA1c <7% group and 177.15±22.27mg/dl in HbA1c ≥7% group [11]. Similarly, the present study's findings align with the above studies as mean FBS in Group A and Group B was 157.03±64.69 and 227±113.48 mg/dl, respectively, which was significant.

In present study mean PPBS in Group A and Group B was 195.97±52.85mg/dl and 224.64±80.87mg/dl respectively. In a similar cross-sectional study by Kadić et al mean PPBS in Group A (n=44, HbA1c ≤7.0%) was 150.5±48.6mg/dl and in Group B (n=62, HbA1c>7.0%) was 268.9±90.24[13]The present study's mean MPV in Group A and Group B was 9.11±0.68mg/dl and 11.05±1.15mg/dl, respectively. In agreement to this study done by Kadić et al reported that mean MPV in Group A (n=44, HbA1c ≤7.0%) and Group B (n=62, HbA1c>7.0%) was 7.95±0.72mg/dl and 8.35±0.72mg/dl respectively[13].Similarly, a study done by Dubey et al. reported that mean MPV in HbA1c <7% and HbA1c≥7% was 7.87±0.54fl and 9.06±1.72 fl, respectively[11].In the present study, MPV in Cases and Control was 10.28±1.37fl and 9.51±0.92 fl, respectively. A survey carried out by Pradhan et al. showed that MPV in diabetic and non-diabetics were 9.89±1.27fl and 8.82±1.14fl, respectively[12] Similarly, a study by Navya et al. reported that the MPV of patients with diabetes was 8.83±0.72 fl, while in nondiabetic patients, it was 7.62±0.42fl[14]A recent study by Navya et al. reported that mean FBS in patients with diabetes was 186.7±60.21mg/dl. In nondiabetic patients was 78.9±4.63mg/dl, and PPBS in diabetic and non-diabetic was 257.02±69.31mg/dl and 130.8±5.53mg/dl, respectively[14].This study was in line with present study findings where mean FBS in diabetic and non-diabetes patients was 199.21±102.57mg/dl and 102.35± 5.56mg/dl, respectively. Another similar study carried out by Pradhan et al. reported that mean FBS in diabetic and non-diabetics was 139.49±52.61mg/dl and 89.71±9.93mg/dl PPBS was 234.6± 84.27mg/dl and 154.14±27.24mg/dl, respectively[12-14]

Conclusion

Age and gender had no statistically significant role on mean platelet volume while correlating it with HbA1c in T2DM. Higher fasting blood sugar levels were found in poor glycemic control patients, and higher postprandial blood sugar levels are found in poor glycemic control patients. For every 1% increase in HbA1c level, there is a 2.5 fl increase in MPV. For every 100mg/dl increase in RBS, there is a 2.96 fl increase in MPV. To conclude, MPV can be an important tool to measure glycemic control in T2DM. We found a higher MPV in those with poor glycemic control compared to patients with good glycemic control. This highlights the utility of MPV in measuring the glycemic control in patients with T2DM.

Conflict of Interest: Nil
Source of support:Nil

References

1. Ranasinghe P, Jayawardena R, Gamage N, Sivanandam N, Misra A. Prevalence and trends of the diabetes epidemic in urban and rural India: A pooled systematic review and meta-analysis of 1.7 million adults. Ann Epidemiol. 2021; 58:128-148.
2. Marques-Vidal P, Bochud M, Bastardot F, von Känel R, Paccaud F et al. Adipocytokines, hepatic and inflammatory biomarkers, and incidence of type 2 diabetes. The CoLaus study. PLoS One. 2012; 7:e51768.
3. Kolb H, Mandrup-Poulsen T. An immune origin of type 2 diabetes? Diabetologia. 2005; 48:1038-50.
4. Liu C, Feng X, Li Q, Wang Y, Li Q, Hua M. Adiponectin, TNF-alpha and inflammatory cytokines and risk of type 2 diabetes: a systematic review and meta-analysis. Cytokine. 2016; 86:100–9.
5. Winocour PD. Platelet abnormalities in diabetes mellitus. Diabetes.1992; 41(Suppl 2):26–31.
6. Zaccardi F, Rocca B, Pitocco D, Tanese L, Rizzi A, Ghirlanda G. Plateletmean volume, distribution width, and count in type 2 diabetes, impairedfasting glucose, and metabolic syndrome: a meta-analysis. Diabetes Metab Res Rev. 2015; 31:402–10.
7. Budak YU, Polat M, Huysal K. The use of platelet indices, plateletcrit, mean platelet volume and platelet distribution width in emergency non-traumatic abdominal surgery: a systematic review. Biochem Med (Zagreb). 2016; 26(2):178-193.
8. Ding Q, Wang F, Guo X, Liang M. The relationship between mean platelet volume and metabolic syndrome in patients with type 2 diabetes mellitus: A retrospective study. Medicine (Baltimore). 2021; 100(13):e25303.
9. Jaman S, Sawgat R, Alam S, Islam R, Husna AU, Sayeed MA. Association of Mean Platelet Volume and Platelet Distribution Width with Hba1c. J Endocrinol Diab. 2017; 4(4):1-6.
10. Dayal A, Kothari S, Shah RJ, Patel SM. Annals of Pathology and Laboratory Medicine. 2016; 3(6-Suppl):A-568-72.
11. Dubey I, Gaur BS, Singh R. A study to find correlation of platelet indices with HbA1c in diabetic patients with absence/presence of vascular complications. International Journal of Research in Medical Sciences. Int J Res Med Sci. 2017; 5(3):1042-1047.
12. Pradhan S, Chinara A, Sahoo BK. Use of mean platelet volume as a tool to assess the progression of type 2 diabetes mellitus. Natl J Physiol Pharm Pharmacol. 2019; 9(3):243-247.
13. Kadić D, Hasić S, Spahić E. Mean platelet volume predicts the glycemic control deterioration in diabetes mellitus type 2 patients. Med Glas (Zenica). 2016; 13(1):1-7.
14. Navya BN, Dhanalakshmi DP, Vivek TG, Kariappa TM. Evaluation of Mean platelet volume as a prognostic marker in type II diabetes mellitus. Journal of Evolution of Medical and Dental Sciences. 2015; 4(19):3261.