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Study of platelet indices in diabetes mellitus patient with respect to HbA1c and its correlation with diabetic complications

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Abstract
Introduction: Diabetes Mellitus (DM) is a pandemic health problem. It is considered as a prothrombotic state with enhanced platelet activity. The increased platelet activity is emphasized to play a role in the development of vascular complications of the metabolic disorder. Mean platelet volume (MPV) is an indicator of average size and activity of platelets. This study was conducted to find correlation of platelet indices with HbA1c in diabetic patients with absence/presence of vascular complications.
Material and Method: Total of 150 patients who were suffering from Type 2 DM and attended Outpatient Department (OPD) in civil hospital Ahmedabad were studied from December 2020 to March 2021. Platelet Indices were measured using automated haematology analyser. The statistical evaluation is done using SPSS version 22. Analysis of variance (ANOVA) is used to compare two variables namely HbA1c <7 and HbA1c ≥7 and diabetics with vascular complications v/s without vascular complications.
Result: MPV is higher in patient with poor glycemic control (HbA1c >7) and in those with vascular complications in compare to patient with HbA1c <7 and those without vascular complications.
Conclusion: The higher values of platelet indices indicates that they serve as better risk indicator of initial vascular complications in diabetes mellitus patients and can be used as a simple and cost-effective tool to assess vascular events.

Keywords: diabetic mellitus, mean platelet volume, vascular complications

Introduction
Diabetes Mellitus is a chronic metabolic disorder. It is a complex disease characterised by chronic hyperglycaemia, metabolic abnormalities resulting in long-term macrovascular and microvascular complications [1]. DM is a major health problem all over the world (pandemic) with high morbidity and mortality rate [1].
Majority of diabetic patients suffer from complications which are mainly due to hyperglycaemia owing to poor glycemic control and altered morphology and activity of platelets. larger platelets, are more enzymatically and metabolically active and have a tendency to form clots leading to both macro and microvascular complications [4, 5].
Glycometabolic control can be monitored by Fasting Blood Glucose (FBG) and Haemoglobin A1c (HbA1c). Platelet functions are measured by platelet indices. Therefore, increased platelet indices may be allied with increased thrombogenic potential.
Platelet indices can be measured by automated haematology analysers as a routine haematological procedure [1]. MPV is indicator of the average size, hence activity of platelets. Variability in the platelet size can be measured by PDW. Increased PDW means platelet size variation and it is elevated earliest than other platelet parameters in diseases affecting platelets.
The present study aimed to evaluate the variation in platelet indices among patients with DM, to determine the association between platelet indices and complications due to diabetes and also estimation of the correlation between platelet indices with glycaemic control (HbA1c) to know whether platelet indices can be of any help in the early diagnosis of thromboembolic events in DM.

Materials and Methods

The present study was prospective and cross/sectional study and carried out at Department of Pathology, B.J. Medical college and civil hospital, Ahmedabad.

Total of 150 patients who were suffering from Type 2 DM and attended Outpatient Department (OPD) were studied from December 2020 to March 2021.

Inclusion criteria

1. OPD based patients suffering from Type 2 DM.

Exclusion criteria

1. Patients with anaemia, Hb<12 gm% in male &<11 gm% in female.
2. Any patients with diagnosed malignancy.
3. Patients on antiplatelet drugs.
4. Known case of quantitative and qualitative platelet disorder.

All diabetic patients underwent a complete clinical evaluation with specific reference to any diabetic complication and drug intake. After taking the detailed history and clinical examination, patient's blood was collected in Ethylenediaminetetraacetic Acid (EDTA) tube and was processed in automated haematology analyser (HORIBA XLR) within two hours of the collection to minimise variation due to sample ageing.

The sample for FBS and HBA1c was collected in sodium fluoride and EDTA vacutainer respectively. The sample was then maintained at room temperature. The estimation of FBS was carried out in Lablife chemistry analyser and HbA1c was estimated by Proviso-merilyser by nephelometric method.

After analysing variation in platelet indices, all 150 diabetic patients were divided into two groups, Group A i.e., patients without diabetic complications (52, 34.6%) and Group B i.e., patients with diabetic complications (98, 65.3%). Then all 150 diabetic patients were again divided in Group I and Group II, based on their HbA1C levels <7% and ≥7% respectively.

Statistical analysis

The statistical software namely statistical package for the social sciences (SPSS) version 22 is used for analysis of data. Analysis of variance (ANOVA) is used to compare the variables. Data is expressed as mean ±standard deviation. The p-value was calculated for each parameter and $p<0.05$ is considered statistically significant. Student t-test was used for doing comparison between two variables namely HbA1c <7 v/s HbA1c ≥7 and diabetics with vascular complications v/s without vascular complications.

Results

Diabetic group was divided into two groups on the bases of HbA1C value. Group 1 with HbA1c levels ≤7% and Group 2 with HbA1C level > 7%. Out of 150 patients in the diabetic group 34 patients showed HbA1c levels ≤7% and 116 patients showed HbA1C to be > 7%. Fasting plasma glucose was significantly raised in group 2 with HbA1C >7%.

The majority of patients were in age group of 40-59 years. Males are marginally more in number (55%) than female in this study.

Table 1: Age distribution of cases and controls

Age Group	No. of Patients/Controls	Percentage
25-40	10	6%
40-59	72	48%
60-79	52	35%
>80	16	11%

Table 2: Comparison of various parameters in two groups of diabetic patients with reference to HbA1c level.

Parameters	HbA1c ≤7%	HbA1C >7%	p-value	Statistical significance
Mean fasting plasma glucose(mg/dl)	134±11.1	172±24.8	<0.05	S
Mean platelet count(lacs/cmm)	2.55±0.61	2.88±0.73	>0.05	NS
Mean platelet volume (fl)	7.47±0.62	9.22±1.42	<0.05	S
Platelet Distribution Width (PDW)	16.3±0.90	18.1±9.45	>0.05	NS

All the platelet indices (platelet count, MPV and PDW) were found to be raised in group 2 with HbA1C >7 %. But value of MPV between the two groups shows statistically significant difference in their value with p value<0.05.

Out of 150 patients in the present study, (98, 65.3%) patients had complications such as diabetic foot, hypertension, coronary artery disease, diabetic retinopathy, diabetic nephropathy, autonomic neuropathy, peripheral neuropathy, peripheral vascular disease, hypercholesterolemia and hypertriglyceridemia and 52 (34.6%) cases did not present with complications.

Cardiovascular complications are the most common cause of mortality and morbidity among diabetics. In present study majority of diabetics patients were suffering from cardiovascular disease (39.79%).

Table 3: Various complications developed in patents of DM

Complications	No. of Patients	% of Patients
Cardiovascular	39	39.79
Diabetic retinopathy	4	4.08
Diabetic nephropathy	2	2.04
Cerebrovascular	2	2.04
Diabetic foot	30	30.61
Others	7	7.14
Multiple	14	14.28

Table 4: Comparisons of glycemic characteristics of diabetic patients without diabetic complications (Group A) and with diabetic complications (Group B).

Parameters	Group A	Group B	p-value	Significance
FPG (mg/dl)	140±15.39	188±28.1	<0.05	S
HbA1C (%)	8.56±1.48	11.1±1.95	<0.05	S

Both FBS and HbA1c were higher in patients with complications due to DM than patients without complications and statistically significant.

Table 5: Comparison of platelet indices in diabetic patient without diabetic complications (Group A) and with (Group B) diabetic complications.

Platelet Indices	Group A (mean±SD)	Group B (mean±SD)	P Value	Significance
Mean platelet count(lacs/cumm)	2.66±0.82	2.78±0.96	> 0.05	NS
Mean Platelet Volume (MPV) (fl)	8.22±1.41	10.82±2.25	< 0.05	S

From the table, we conclude that the platelet indices increase in patients with a poor glycemic status but Mean platelet volume in diabetic group with vascular complications which is found to be raised in comparison to the group without vascular complications which is statistically significant with p value <0.05. HbA1c and MPV found to be raised in diabetes with vascular complication.

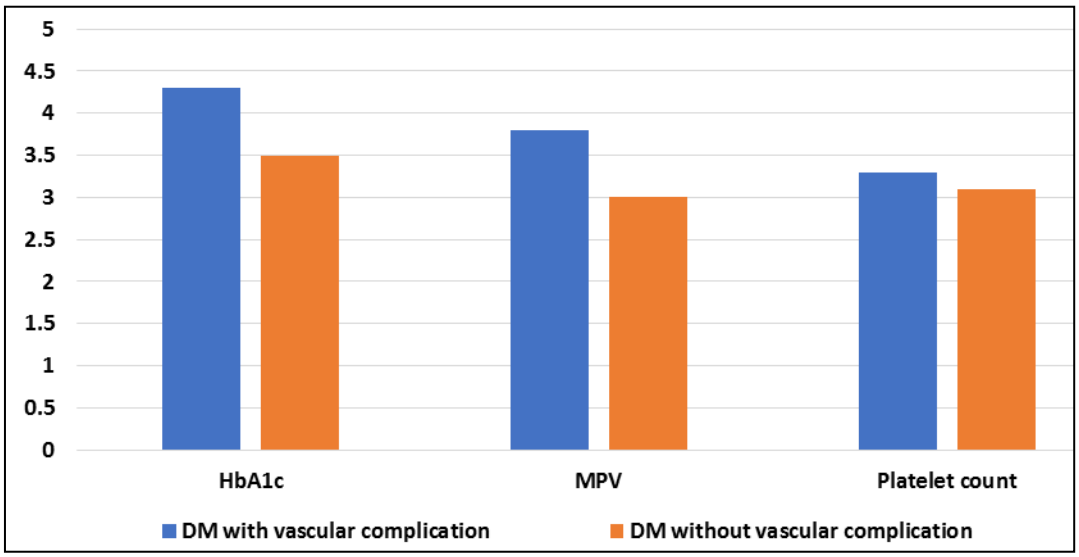

Fig 1: Comparison of HbA1c and mean platelet parameters with complication and without complication in DM.

Discussion

DM is the most common endocrine disorder. Aetiology of DM is multifactorial, large platelets play an important role in the development of complications due to DM. Main reasons for abnormal platelet functions in DM are immature, larger platelets and activated platelets.

Due to vascular damage, there is enhanced platelets hyperaggregability and platelet activation causing circulating platelets to release more granules which causes reduce survival of platelets and hence releasing larger platelets from bone marrow. This is because of increased ploidy and activation of megakaryocytes.

In this study, all diabetic patients were divided into two groups according to their HbA1c levels: group 1 consist of patients with HbA1c levels ≤7% and group 2 consist of patients with HbA1c levels >7%. And the patients are subgroup into Group A and B with respect to Diabetic complications

i.e. Group A: patients without diabetic complications, Group B: patients with diabetic complications.

On comparing platelet indices with glycaemic control, patients with poor glycaemic control (HbA1C >7%) had higher platelet indices than patients with good glycaemic control but we found statistically significant difference between the groups with regard fasting blood sugar and MPV.

On comparing various parameters between patients suffering from diabetic complications and diabetic patients without any diabetic complications, it was observed that all the platelet indices (platelet count, MPV and PDW) were higher in patients with complications as compared with patients without complications but we found statistically significant difference with regard fasting blood sugar, HbA1c and MPV.

Earlier studies have emphasized that HbA1c is specific sensitive and significant method for estimation of glycemic levels. HbA1c increases with poor glycemic control. Both FBS and HbA1c were higher in patients with complications due to DM than patients without complications which is statistically significant with p value <0.05.

Table 6: Comparison of Finding of MPV of diabetic patients with reference to HbA1c level in present study and different studies.

Study	MPV (in patient with HbA1c >7%) in fl	MPV (in patient with HbA1c <7%) in fl	significance
Present study	9.22+1.42	7.47+0.62	S
Lis *et al.*	13.2±1.9	11.8±1.7	S
Demirtune R *et al*.	9.0±0.7	8.4±0.8	S
Ozder and Eker	10.17± 0.83	10.30± 0.92	S

In this study platelet indices (platelet count, MPV and PDW) were significantly raised in patient with poor glycemic control as compared to those with good control (HbA1c <7%) but there was statistically significant difference in MPV. This result is quite similar to other study done by Lis *et al*, Demirtune R et, Ozder and Eker.

Conclusion

Our study suggests that extent of increment of platelet indices is more in diabetic patients with poor glycemic control (HbA1c >7). This increased platelet volume indices and larger platelets contributes to the prothrombotic state in diabetes mellitus. Because larger platelets are hemostatically more active, therefore its presence probably is a risk factor for developing diabetic vascular complications. This Increased platelet indices which are also directly proportion to diabetic complications. early diagnosis of progressive activation of coagulation can help manage these vascular diseases successfully. Thus MPV might be used as a simple and cost – effective laboratory test in the follow up of DM along with HbA1c and there by useful in predicting an impending thrombotic state and early diagnosis of vascular complications of diabetes.

Sample size of our study is smaller, study with larger sample size will give us more insight into relationship of platelet indices with diabetes and its diabetic complications. Another limitation of the study is that other cofounding factors like hypertension, obesity etc. which also affects platelet indices have not been taken into consideration.

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