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Original Research Article

A Cross-Sectional Study For Evaluation of Platelet Indices in Patients With Type 2 Diabetes Mellitus

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Abstract

Background: Diabetes mellitus has become a major global health problem. It's a state of hyperglycemia which causes spectrum of long term systemic complications having considerable impact on individuals in their most productive years. Altered platelets have been reported in such patients and has been considered as a 'prothrombotic state'. Identification of such patients can be easily made by simple routine haematological analysis which is a cost-effective tool that could possibly benefit the diabetic patients by preventive actions.

Methods: A cross sectional hospital based study of platelet parameters MPV, PDW, PCT and P-LCR was carried out on 110 diabetic patients from December 2019 to May 2021. Complete blood count with platelet parameters PC, MPV, PDW, PCT, P-LCR, FBS and PPBS, HbA1c, ECG, FLP, RFT and microalbuminuria was done . Statistical evaluation was performed by using Student's t test and Pearson correlation test.

Results: In the present study, maximum proportion of patients were in the age group of 61-70 years accounting for 37.27%.With regards to MPV, 49% of them had the values between 8.9 -11.8 fl, and about a quarter of them had MPV above 11.8fl. Majority (88%) of them had their PDW above 15.3 fl. Majority (66%) of diabetics had the plateletcrit value above 0.24%. total of 53.63% patients had the LCR above 35%. Thus it was seen that a quarter of the population had higher MPV, 88% of them had a higher PDW, 66% of them had a higher PCT value and just above 50% of them had LCR above 35%. It was also seen that more the duration of diabetes, higher the MPV and LCR. Pearson's correlation showed that there was a positive relationship between MPV and HbA1c suggesting that as the HbA1c increases, MPV value also increases. A Student T test was done to assess the relationship between presence of microvascular complications and platelet indices. MPV and LCR were higher among those with microvascular complications when compared to those without complications. This relationship was also found to be statistically significant with p value <0.05.

Conclusion: Longer the duration of diabetes, higher the MPV and P-LCR. There was a positive relationship between MPV and HbA1c suggesting that as the HbA1c increases, MPV value also increases. MPV and P-LCR were higher among those with microvascular complications compared to without complications.

Keywords: Platelet Indices, Mean Platelet Volume, Platelet Distribution Width, Platelet- Large Cell Ratio, Diabetes Mellitus.

Introduction

Diabetes Mellitus (DM) is a chronic metabolic disorder which is fast growing global problem with huge social, health and economic burden in both developed as well as developing nations [1]. DM refers to group of common metabolic disorders that share the phenotype of hyperglycemia in which several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Diabetes is often associated with increased risk of micro and macrovascular complications which are responsible for the majority of morbidity and mortality associated with the disease. Patients with DM have increased risk of premature cerebral, coronary, and peripheral vascular disease which together constitute the leading cause of death in these patients. The increased risk is independent of and additive to other cardiovascular risk factors, such as hypertension, albuminuria, obesity, cigarette smoking, and dyslipidemia when compared to non-diabetic patients with these comorbidities. DM is also characterized by the prothrombotic state of platelets which owes to the persistent hyperglycemia and insulin resistance [2]. Insulin inhibits activation of platelets and associated functions, hence relative or absolute deficiency of insulin would increase platelet reactivity and leads to atherosclerotic complications. Diabetes is also associated with

oxidative stress and inflammation activity in the body. Hence resultant endothelial dysfunction promotes activation of platelets by decreasing nitric oxide production which is a potent inhibitor of platelet adhesion, aggregation. Leading to micro and macrovascular complications. [1]

Platelet activity and aggregation, which are essential events of atherosclerosis [3] and thrombus formation eventually leading to micro and macro vascular complications in diabetic patients can be estimated by measuring various platelet indices such as Mean platelet volume (MPV), Platelet distribution width (PDW), plateletcrit (PCT), Platelet large cell ratio (P-LCR). These parameters can be easily determined on routine blood analysis which is simple, cost effective tool measured by routine haematological analyzer and could possibly benefit the diabetic patients by preventive actions as a large number suffer from preventable vascular complications.

The purpose of this study is to determine the correlation between platelet activity and type2 DM, and also to analyse and compare various platelet indices between type 2 DM with respect to its duration of disease and microvascular complications and also to analyse all the indices correlation with HbA1c levels. Studies have shown that platelet indices are significantly increased in diabetics with vascular complications.[4,5,6,7,8], Identification of such patients can be easily made by simple routine haematological analysis which helps in easy detection of prothrombotic state of the patients and is a cost-effective tool. Analysing the platelet parameters such as mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), P-LCR, can act as an alarm for diagnosing and progression of complications of diabetes mellitus. In rural setup like sullia studies related to diabetes and its complications are done in less number, hence this study was conducted.

Materials and Methods

This is a cross sectional study was conducted in a tertiary care centre of Sullia. Sample size of around 110 subjects, irrespective of the gender, who meet the inclusion and exclusion criteria and visit the hospital on an outpatient and inpatient basis in were taken. A pilot study was done to assess the proportion of diabetics with microvascular complications.

1. Informed written consent, detailed history was taken and clinical examination was done.
2. Selected population was asked about demographic details, duration of diabetes, family history of diabetes.
3. Diabetic retinopathy was diagnosed when there was at least two micro aneurysms and/or retinal hemorrhage and findings of retinal damage on fundus examination.
4. Diabetic nephropathy was diagnosed when urine proteinuria is present and protein creatinine ratio level is between 30-299 mg/g in a random midstream urine sample.
5. Diabetic neuropathy was diagnosed according to the symptoms and physical examination of the patients after excluding other causes of neuropathy.
6. Coronary artery disease is diagnosed when there was a history of myocardial infarction, significant ECG changes, coronary artery bypass grafting.
7. Complete blood count with platelet parameters PC, MPV, PDW, PCT, large cell ratio, fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c, 12 lead ECG, lipid profile, carotid arterial intimal thickening, renal function tests and routine urine examination (RUE) with microalbuminuria was done in sullia and study is conducted.

Inclusion Criteria

1. Type 2 diabetics with and without microvascular complications.
2. Age of more than 40yrs.
3. Participants willing for the study.

Exclusion Criteria

1. Blood transfusion in last 14 days.
2. Bleeding tendencies or blood loss.
3. Patients on antiplatelets therapy.
4. Known case of malignancy disorder on chemo or radiotherapy.
5. Anemia/myeloproliferative disorder.
6. H/O drugs like NSAIDs, other than oral hypoglycemic drugs or bone marrow suppression
7. Pregnancy.
8. Any infections.

Statistical Analysis

The data entered in Microsoft Office Excel 2007 and IBM SPSS version 21 was used for analysis. The data presented in the form of tables and figures. The data represented as frequencies, percentages, mean and standard deviation. Chi square test and t test were used to assess the relationship between the variables and p value less than 0.05 was considered as significant.

Results

Table 1: Age and Gender Distribution in the Study Population

Sr no.	Age Distribution	No. Of Males	No. Of Females	No. Of Patients
1	40 – 45 Years	9 (8.18%)	6 (5.45%)	15 (13.63%)
2	46 – 50 Years	6 (5.45%)	5 (4.54%)	11 (10%)
3	51 – 55 Years	3 (2.72%)	6 (5.45%)	9 (8.18%)
4	56 – 60 Years	9 (8.18%)	6 (5.45%)	15 (13.63%)
5	61 – 65 Years	10 (9.09%)	10 (9.09%)	20 (18.18%)
6	66 – 70 Years	10 (9.09%)	11 (10%)	21 (19.09%)
7	71 – 75 Years	2 (1.81%)	6 (5.45%)	8 (7.27%)
8	76 – 80 Years	3 (2.72%)	4 (3.63%)	7 (6.36%)
9	81 – 85 Years	3 (2.72%)	0 (0%)	3 (2.72%)
10	86 – 90 Years	0 (0%)	1 (0.90%)	1 (0.90%)
	Total	55 (50%)	55 (50%)	110 (100%)

In our study group maximum patients belongs to age group of 61 to 70 years. 20% belongs to the age group 61-65 years, 21 % belongs to age group 66-70 years.

Table 2: Fundus Findings In The Study Population

Sno.	Fundus Findings	No. Of Patients
1	Normal	38 (34.54%)
2	Mild NPDR	36 (32.72%)
3	Moderate NPDR	32 (29.09%)
4	Severe NPDR	2 (1.81%)
5	PDR	2 (1.81%)

Among 110 diabetic patients enrolled for this study, 38(34.54%) diabetic patients are found to have normal fundus. A total of 68 diabetic patients were found to have NPDR, amongst which 36(32.72%) were g found to ahbve only mild npdr changes, while 32(29.09%) were found tyo have ,moderate npdr changes. However only two dioabetic patients were found to have severe npdr, and another two diabetic patients were found to have pdr.

Table 3: Peripheral Neuropathy in the Study Population

Sno.	Peripheral Neuropathy	No. of Patients
1	Present	23 (20.90%)
2	Absent	87 (79.09%)

Amongst total of 110 diabetic patient only 23(20.9%) were found to be having clinically peripheral neuropathy while the remaining showed no evidence of the same.

Table 4: Microalbuminuria in the Study Population

Sno.	Microalbuminuria	No. of Patients
1	≤ 300 mg	108 (98.18%)
2	> 300 mg	2 (1.81%)

Amongst all the diabetic patients enrolled in this study, only two were found positive for microalbuminuria (> 300mg) while the remaining 108 patients were negative for albumin in the urine.

Table 5: Fasting Blood Sugars in the Study Population

Sno.	Fasting Blood Sugar	No. of Patients
1	≤ 99 mg/dl	6 (5.45%)
2	100 – 125 mg/dl	16 (14.54%)
3	≥ 126 mg/dl	88 (80%)

In this study 110 known diabetic patients were enrolled. Their fasting sugar values were done. 88 (80%) patients were found to have ≥ 126mgdl, 16 (14.54%) patients were having FBS between 100-125 mg/dl while only 6 (5.45%) patients were having FBS values <100mg/dl.

Table 6: Postprandial Blood Sugars in the Study Population

S no.	Post Prandial Blood Sugar	No. Of Patients
1	< 140 mg/dl	3 (2.72%)
2	140 – 199 mg/dl	13 (11.81%)
3	> 200 mg/dl	94 (85.45%)

In this study 110 known diabetic patients were enrolled. Their post prandial sugar values were done. 3 (2.72%) patients were found to have ≤140mgdl, 13 (11.81%) patients were having PPBS between 140-199 mg/dl, while only 94 (85.45%) patients were having PPBS values >200mg/dl.

Table 7: Hba1c in the Study Population

S no.	HbA1c	No. of Patients
1	< 5.7 %	1 (0.90%)
2	5.7 – 6.4 %	2 (1.81%)
3	≥ 6.5 %	107 (97.27%)

Amongst total of 110 diabetic patients enrolled for the study 107(97.27%) were having HbA1c levels ≥6.5%, only two patients were having hba1c levels in between 5.7 to 6.4 %, and only one patient was found toi have hba1c level < 5.7.

Table 8: Distribution of Patients Based on their Platelet Count

S no.	Platelet Count	No. of Patients
1	< 1.5 Lakhs / µL	3 (2.72%)
2	1.5 – 4.5 Lakhs / µL	98 (89.09%)
3	> 4.5 Lakhs / µL	9 (8.18%)

Among the diabetic population, 98(89.97%) patients had normal range of platelet count1.5 to 4.5lakh/ul, 3(2.72%) patients had reduced platelet count <1.5lakh/ul, 9% had increased platelet count>4.5lakh/ul.

Table 9: Distribution of Patients Based on Their Mean Platelet Volume

S no.	Mean Platelet Volume	No. of Patients
1	< 8.9 fl	29 (26.36%)
2	8.9 – 11.8 fl	54 (49.09%)
3	> 11.8 fl	27 (24.54%)

In our study, 54(49.09%) patients had normal range of MPV between 8.9 to 11.8fl, 29(26.36%) patients had reduced MPV<8.9fl, and 27(24.54%)patients had MPV value >11.8fl.

Table 10: Distribution of Patients Based on their Platelet Distribution Width

S no.	Platelet Distribution Width	No. of Patients
1	< 9.6 fl	0 (0%)
2	9.6 – 15.3 fl	13 (11.81%)
3	> 15.3 fl	97 (88.18%)

Amongst total of 110 diabetic patients enrolled for the study 97(88.18%) were having PDW levels ≥15.3fl, only 13 patients were having PDW of levels in between 9.6 to 15.3fl, and only no patient was found to PDW below level < 9.6fl.

Table 11: Distribution of Patients Based on their Plateletcrit Values

S no.	Plateletcrit	No. of Patients
1	< 0.22 %	22 (20%)
2	0.22 – 0.24 %	15 (13.63%)
3	> 0.24 %	73 (66.36%)

In our study, total diabetic patients who had increased platelecrit (>0.24%) are 73(66.36%), patients who had plateletcrit of 0.22 to 0.24% are 15(13.63%) and 22(20%) patients had low plateletcrit of <0.22%.

Discussion

In the present study, the age ranged from 40-90 years. The mean age of patients in the present study was 60.63 ± 11.41 years. Majority of the patients diagnosed with Type 2 DM belonged to 6th decades of life. This is comparable with other studies. The mean platelet volume in the present study was 10.50 fl. This was within the normal range. Similarly other studies also showed that the mean platelet volume was within the normal range.

MPV is an indicator of the average size and activity of platelets. Larger platelets are younger, more reactive and aggregable. Hence, they contain denser granules, secrete more serotonin and β-thromboglobulin, and produce more thromboxane A2 than smaller platelets.[9]All these can produce a pro-coagulant effect and cause thrombotic vascular complications. This suggests a relationship between the platelet function especially MPV and diabetic vascular complications thus indicating changes in MPV reflect the state of thrombogenesis. [10]

There might be small bleeds due to the rupture of atherothrombotic plaques leading to increased platelet recruitment, hyper reactivity, and bone marrow stimulation. High MPV is emerging as a new risk factor for the vascular complications of DM of which atherothrombosis plays a major role. [11] Thus, DM has been considered as a "prothrombotic state" with increased platelet reactivity. [12] A direct relation between platelet dysfunction and the development of diabetic complications has yet to be firmly established. [13]

Demirtunc et al[14]suggested in his study that platelet dysfunction begins at the early stages of

diabetes even before symptoms appear and vascular pathology and thus MPV can be used as a cost effective and easy method to evaluate platelet function and activity. However they also concluded that improved glycemic control decreases MPVand may prevent possible role of platelets in thrombotic events in type2 DM.

In the present study, mean PDW was 18.95 ± 16.35. This showed that PDW was significantly elevated among the type2 diabetic cases. Other studies also showed that PDW was high among diabetics.

Jabeen et al[15]observed highly significant PDW value in diabetic cases in comparison to control subjects in their study which is because of the fact that, in addition to thrombopoietin (a chief hormonal regulator of platelet production) nitric oxide which is generated during oxidative stress in diabetes, can also stimulate platelet production.

In the present study, The mean platelet large cell ratio was 34.12%. This is similar to other studies.

Ashraf et al[16]reflected a sequential disease burden measurement index of progressive diabetes visible by platelet parameters to distinguish controlled, controllable and uncontrolled diabetic population from non-diabetic population. They also evaluated biochemical parameters like HDL and triglycerides for possible link between platelet reactivity and these parameters, and observed that elevated triglycerides and decreased HDL levels are the best predictors of cardiovascular disease in patient with type 2 diabetes.

Thus, larger platelets are more reactive and contribute to vaso-occlusive events in diabetic patient. Hence, P-LCR may serve to identify larger more active platelets during development of thromboembolic ischemic events in diabetic cases.

Conclusion

In the present study, the duration of diabetes was associated with mean platelet volume and large cell ratio. More the duration of diabetes, higher the MPV and Large cell ratio. Pearson's correlation showed that there was a positive relationship between MPV and glycated hemoglobin suggesting that as the glycated hemoglobin increases, MPV value also increases. A Student T test was done to assess the relationship between presence of microvascular complications and platelet indices. MPV and Large cell ratio were higher among those with microvascular complications when compared to those without complications. This relationship was also found to be statistically significant with p value less than 0.05.

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