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CO-RELATION OF PLATELET VOLUME INDICES WITH LIPID PROFILE IN DIABETIC AND NON-DIABETIC PATIENTS: A CASE CONTROL STUDY

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ABSTRACT

Introduction: Diabetes mellitus is a metabolic disorder on increasing trend due to modern industrial lifestyle in India. The objective of the study was to compare platelet volume indices and lipid profile of diabetic cases and non-diabetic controls and to study correlation of platelet volume indices with lipid profile in diabetic patients. **Methods:** A hospital based case control study was conducted among 100 diabetic cases and 100 non-diabetic controls. Various investigations including platelet volume indices and lipid profile were done in both the groups. Biochemical parameters were measured using standard procedures. Laboratory normal reference ranges were used for comparison. **Results:** In diabetic patients, Mean Platelet Volume (MPV), Platelet distribution width (PDW) and Platelet Large Cell Ratio (PLCR) were found to be 14.47 ± 4.536, 15.09 ± 3.544 and 30.48 ± 8.139 respectively. In non-diabetics these indices were 8.78 ± 1.117, 9.38 ± .936 and 20.99 ± 6.813 respectively. There were statistically significant differences in Total Cholesterol (TC), Low Density Lipoprotein (LDL) and Triglyceride (TG) among diabetics and non-diabetics. These differences were found in both the genders. MPV and PLCR were positively correlated with TC, TG, HDL and LDL, which were found statistically significant. **Conclusion:** There were significant differences in platelet volume indices and lipid profile of diabetic patients and non-diabetic controls. Positive correlation between platelet volume indices and lipid profile in diabetic patients was found which was statically significant.

KEYWORDS: Diabetes mellitus, HbA1c, Lipid profile, Non-diabetics, Platelet volume indices.

INTRODUCTION

Diabetes mellitus (DM) is a chronic, hereditary and endocrine metabolic disorder affecting the large proportion of population worldwide.[1]

According to world diabetes atlas, an estimated 415 million people had diabetes worldwide in 2015; with type 2 DM making up about 90% of the cases.[2,3]

Certain ethnicity and race predispose people to a greater risk of developing diabetes in Africa and Asia.[4] India, a developing Asian country with fast industrialization and a modern lifestyle is facing a grave problem in having the second largest number of people with diabetes which is estimated to reach 109 million by the year 2035.[5] The Indian studies indicated a threefold rise in the diabetic prevalence in rural as well as urban areas.[6]

The term diabetic dyslipidemia comprises a triad of raised triglycerides (TG), reduced high-density lipoprotein (HDL) and excess of small, dense low-density lipoprotein (LDL) particles. Dyslipidemia is prevalent in diabetes mellitus because of disruption of normal lipid metabolism due to insulin resistance or deficiency.[7] Microvascular and macrovascular complications, including cardiovascular disease (CVD), retinopathy, nephropathy, and neuropathy, occur due to chronic uncontrolled hyperglycemia in diabetics.[8,9]

Type 2 diabetes mellitus patients have two-four folds increase in risk of atherosclerosis. Raised platelet counts and activity have been described in diabetics as demonstrated by Mean Platelet Volume (MPV), the average volume of platelets, a parameter in full blood count measures platelet size distribution and is not influenced by glycemic control.[10] An increased MPV has been associated with high incidence of proliferative diabetic retinopathy and myocardial infarction.[11,12] An activated megakaryocyte-platelet system in diabetes mellitus has been reported to be responsible for larger than normal platelets circulating in DM patients.[11] Platelet volume indices are simple and effective tests that may be used to predict angiopathy in type 2 DM. Elevated MPV has been documented to predict bad

outcome for acute ischaemic cerebrovascular events independent of other clinical parameters.[13]

With this background, the present study was aimed to compare platelet volume indices and lipid profile of diabetic cases and non-diabetic controls and to study correlation of platelet volume indices with lipid profile in diabetic patients.

METHODOLOGY

The subjects enrolled in the study were 100 type 2 diabetic patients who had attended the outpatient department of a tertiary care center. Hundred controls were selected from non-diabetic patients visiting our institution. Males with hemoglobin <12 gm/dl, females with hemoglobin <10 gm/dl, pregnant females, non-diabetic patients with coronary artery disease, diabetics on antiplatelet drugs and subjects with any diagnosed malignancy were excluded from the study. Laboratory tests were used to confirm the absence of diabetes in the control group and also by asking questions about the signs of diabetes such as polyuria, polydipsia, polyphagia and recent weight loss. Information on family history of diabetes was also obtained from the controls and they were subjected to fasting blood sugar before enlistment.

Cases and controls were investigated for random blood sugar, Glycosylated hemoglobin (HbA1C), platelet volume indices (including Mean Platelet Volume, Platelet distribution width and Platelet Large Cell Ratio) and lipid profile (including Total Cholesterol, High Density Lipoprotein, Low Density Lipoprotein and Triglyceride). The study was conducted from June 2015 to December 2015.Written informed consent was taken. Institutional ethical committee approved the study.

The patients were advised to follow all the pre-requisites including twelve-hour fasting for lipid profile. Blood specimen was withdrawn from the ante-cubital vein using a dry sterile disposable syringe and needle in EDTA and Plain vaccutainers. The specimens were labeled with subject's age, sex and identification number. EDTA blood was run for complete blood counts including platelet volume indices. This was run on 5-part Differential Hematology Analyzer (Bensphera H51). Unhemolyzed serum was run on Erba Autoanalyzer for lipid profile. HbA1c was obtained from EDTA blood using immunoturbidometric method. Blood sugar was estimated by Glucose oxidase method.

Data were analyzed using SPSS version 16.0 (Statistical Package for Social Sciences, Inc., Chicago, Ill). The continuous variables were given as means ± standard deviation (SD) and independent t test was applied. P value was considered to be statistically significant when less than 0.05.

RESULTS

Total 200 participants were included in the study with 100 diabetic patients and 100 non-diabetic controls. As shown in Table 1, there were statistically significant differences of FBS, HbA1C and platelet volume indices among diabetic and non-diabetic participants. There was statistically significant difference of lipid profile among diabetic and non-diabetic persons except high-density lipoprotein.

Among male diabetics (n=52) and male non-diabetics (n=46), there are statistically significant differences platelet volume indices and lipid profile. Difference in high-density lipoprotein (HDL) was not found statistically significant (p = 0.348). (Table 2).

Among female diabetics (n=48) and female non-diabetics (n=54), there are statistically significant differences platelet volume indices and lipid profile. Difference in high-density lipoprotein (HDL) was not found statistically significant (p = 0.143). (Table 3).

As shown in Table 4, Mean platelet volume and platelet large cell ratio were found to have positive co-relation with all the variables of lipid profile. These associations were found statistically significant (p value <0.01). Platelet distribution width was positively correlated serum total cholesterol, triglyceride and HDL (p value <0.01). Co-relation between MPV - LDL (p value 0.05) and PDW- LDL (p value 0.125) were not found statistically significant. Platelet Large Cell Ratio was positively co-related with LDL, which was statistically significant (p value 0.047).

Table 1: Platelet indices and Lipid profile in Diabetic and Non-diabetic patients

Sr. No.	Variable	Diabetic patients (n=100) Mean ± SD	Non-diabetic Controls (n=100) Mean ± SD	P value
1.	**Age**	51.21 ± 10.658	45.15 ± 13.475	0.001
2.	**FBS**	177.28 ± 24.129	83.88 ± 6.535	<0.001
3.	**HBA1C (%)**	8.20 ± 1.326	5.62 ± 0.565	<0.001
4.	**MPV**	14.47 ± 4.536	8.78 ± 1.117	<0.001
5.	**PDW**	15.09 ± 3.544	9.38 ± .936	<0.001
6.	**PLCR**	30.48 ± 8.139	20.99 ± 6.813	<0.001
7.	**Duration (in years)**	4.84 ± 2.666		
8.	**Cholesterol**	172.78 ± 38.259	119.68 ± 15.841	<0.001
9.	**Triglyceride**	158.29 ± 62.783	77.25 ± 17.583	<0.001
10.	**HDL**	55.49 ± 13.793	58.25 ± 8.617	0.091
11.	**LDL**	99.29 ± 13.938	88.60 ± 9.309	<0.001

FBS (Fasting Blood Sugar), HbA1c (Glycated Hemoglobin), MPV (Mean Platelet Volume), PDW (Platelet Distribution width), PLCR (Platelet Large Cell Ratio), HDL (High Density Lipoproteins), LDL (Low Density Lipoproteins).

Table 2: Correlation of Platelet indices and Lipid profile in Diabetic and Non-diabetic males

Sr. No.	Variable	Diabetic males (n=52) Mean ± SD	Non-diabetic males (n=46) Mean ± SD	P value
1.	Age	52.23 ± 11.810	46.02 ± 13.116	0.015
2.	FBS	174.40 ± 25.769	83.28 ± 6.424	< 0.001
3.	HBA1C (%)	8.06 ± 1.305	5.59 ± 0.652	< 0.001
4.	MPV	14.54 ± 4.535	8.66 ± 1.055	< 0.001
5.	PDW	14.58 ± 3.776	9.21 ± 0.701	< 0.001
6.	PLCR	29.44 ± 8.169	20.14 ± 5.816	< 0.001
7.	Duration (in years)	4.79 ± 2.754		
8.	Cholesterol	176.12 ± 38.966	119.39 ± 16.910	< 0.001
9.	Triglyceride	159.19 ± 64.202	75.89 ± 15.607	< 0.001
10.	HDL	55.90 ± 13.713	58.20 ± 9.704	0.348
11.	LDL	98.87 ± 13.740	89.30 ± 11.063	< 0.001

Table 3: Co-relation of Platelet Volume Indices and Lipid profile in Diabetic and Non-diabetic females

Sr. No.	Variable	Diabetic females (n=48) Mean ± SD	Non-diabetic females (n=54) Mean ± SD	P value
1.	Age	50.10 ± 9.249	44.41 ± 13.852	0.018
2.	FBS	180.40 ± 22.062	84.39 ± 6.646	< 0.001
3.	HBA1C (%)	8.35 ± 1.345	5.65 ± 0.482	< 0.001
4.	MPV	14.40 ± 4.585	8.89 ± 1.167	< 0.001
5.	PDW	15.64 ± 3.222	9.53 ± 1.083	< 0.001
6.	PLCR	31.61 ± 8.038	21.72 ± 7.538	< 0.001
7.	Duration (in years)	4.90 ± 2.595		
8.	Cholesterol	169.17 ± 37.550	119.93 ± 15.027	< 0.001
9.	Triglyceride	157.31 ± 61.872	78.41 ± 19.176	< 0.001
10.	HDL	55.04 ± 14.011	58.30 ± 7.664	0.143
11.	LDL	99.75 ± 14.281	88.00 ± 7.561	< 0.001

Table 4: Pearson Co-relation co-efficient values between platelet volume indices and lipid profile

Sr. No.	Variable	Cholesterol	Triglyceride	HDL	LDL
1.	MPV	0.622 *	0.582 *	0.565 *	0.197
2.	PDW	0.479 *	0.492 *	0.423 *	0.155
3.	PLCR	0.583 *	0.527 *	0.481 *	0.199 †

DISCUSSION

In the present study, we have studied platelet volume indices and lipid profile of 100 diabetic and 100 non-diabetic participants. Study comprised of 98 male participants and 102 female participants.

Diabetic patients are at risk of increased thrombosis and atherogenesis. Changes in hemostatic balance constitute a pathogenic a role in development of complications in DM patients. Role of platelets in hemostatic balance and an increase in thrombotic adhesion, aggregation and secretion have been shown in many of the previous studies.[14,15]

In our study, mean platelet volume is significantly high in diabetics as compared to non-diabetics ($p < 0.001$). These differences were also found when gender wise comparisons were done. Studies by Sharp et al. and Hekimsoy et al. have found similar results.[10,16] Mean platelet volume is an indicator showing thrombosis function and activation. Large platelets display high thrombotic potential.[17] Increased MPV levels have been shown as an indicator in myocardial infarcts, congestive heart disease, cerebrovascular diseases, obesity and hypertensive patients.[18-22] Study done by Yang et al. proposed a relationship between high MPV levels and an increase in the frequency of restenosis in patients who received coronary angioplasty.[23] Henning et al. had shown a relationship between increased MPV and increased CAD incidence in chronic hemodialysis patients.[24]

According to our study, lipid profile test which include total cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL) and triglyceride were found deranged in case of diabetic patients, which are well known risk factors for cardiovascular diseases among patients, when compared to the normal values. Similar results were found in comparisons made gender wise (Table 1-3). Differences were found statistically

significant for total cholesterol, low-density lipoprotein (LDL) and triglyceride among diabetic and non-diabetic participants ($p < 0.001$). Both lipid profile and diabetes have been shown to be the important predictors for metabolic disturbances including dyslipidemia, hypertension and cardiovascular diseases.[25] Krauss et al. reported abnormalities in lipid metabolism in patients with diabetes mellitus accompanied by the risk of cardiovascular arteriosclerosis.[26]

In our study, we have found higher values of Platelet distribution width (PDW) and Platelet Large Cell Ratio (PLCR) in diabetic patients when compared to non-diabetics. These differences were found to be statistically significant ($p < 0.001$). Mean value for PLCR for both the groups fall within the normal range which shows that diabetes doesn't affect PLCR up to the extent where it become abnormal.

In our study, mean platelet volume and platelet large cell ratio were found to have positive correlation with all variable of lipid profile. These associations were found statistically significant. Microvascular and macrovascular complications, including cardiovascular disease (CVD), retinopathy, nephropathy and neuropathy are associated with abnormal lipid profile and uncontrolled hyperglycemia in diabetics.[8,9] Several authors have suggested that patients with Type II DM have increased MPV when compared with non-diabetic and among the diabetics, those with vascular complications presented higher MPV values.[15,16] From this discussion, we can conclude that the risk of cardiovascular complications can be estimated by use of MPV values.

Platelet distribution width was positively correlated serum total cholesterol, triglyceride and HDL (p value <0.01). The present study also showed that diabetic patients had higher PDW when compared to those without diabetes, a finding that has also been described by Dalamaga et al.[27] The activated platelets differ in size from non-activated ones mainly due to a change from a discoid to a spherical shape and pseudopodia formation, leading to a change in the PDW, as observed by Vagdatli et al.[28] In a study by Jindal et al., significant differences were found in PDW parameter in diabetic patients with complications when compared with diabetics without complications.[15] These findings can be attributed to the accelerated production of platelets in patients with type II DM. Overall, study findings suggest that MPV and PDW can be used for prediction of diabetes related atherosclerosis and thrombosis.

CONCLUSION

Platelet volume indices and lipid profile were significantly higher in diabetic patients compared to non-diabetic control. These differences were also significant in both the genders. Mean platelet volume and platelet large cell ratio were positively correlated with serum total cholesterol, triglyceride, high-density lipoprotein and low-density lipoprotein which was found statistically significant. This proves that along with dyslipidemia, platelet volume indices can also be used as a predictive marker for diabetic complications.

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