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Original Research Article

A cross-sectional study to find out association of mean platelet volume and development of microvascular complication in diabetics in Western Rajasthan

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Abstract

Background: Diabetic patients have an increased risk of developing micro- vascular and macro vascular disease, and platelets may be involved as a causative agent with respect to altered platelet morphology and function. Aim of our study was to determine if platelets were activated in diabetes and to see if there was a difference in MPV in diabetics and non-diabetics.

Methodology: A cross sectional study had been conducted to study the impact of HBA1C on mean platelet volume in Type 2 diabetic patientsand to find out association of mean platelet volume and development of microvascular complication (neuropathy, nephropathy andretinopathy) in diabetics in western Rajasthanattending the Medicine Outdoor and indoor at M.D.M. Hospital Jodhpur.

Conclusion: Platelets in Diabetes Mellitus become more reactive and agreeable and their Mean Platelet Volume (MPV) is increased. Increase in HbA1c concentration is directly proportional to increased MPV, thus poor glycemic control causes increase in MPV which result in more chance of developing microvascular complication. However, the increased MPV as the cause or the end result of microvascular complications needs to be further explored. Hence, we propose that MPV can be used as simple and cost effective tool to monitor the progression and control of Diabetes Mellitus and its associated microvascular complications.

Keywords: Mean platelet volume, complications, diabetics, cross sectional study

Introduction

Diabetes mellitus (DM) is a leading medical problem throughout the world. Diabetes causes long–term systemic complications that have considerable impact on the patient as well as society, as the disease typically affects individuals in their most productive years[1,2].Prevalence of diabetes is increasing throughout the world. In addition, this increase appears to be greater in developing countries[3, 4]. The etiology of this increase involves changes in diet, with higher fat intake, sedentary lifestyle changes, and decreased physical activity.

The increased platelet activity may play a role in the development of vascular complications of this metabolic disorder[5,6]. The mean platelet volume (MPV) is an indicator of the average

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size and activity of platelets. Larger platelets are younger and exhibit greater activity. The increased platelet activity is emphasized to play a role in the development of vascular complications of this metabolic disorder[7,8].

Methodology

Study Design

A cross sectional study was conducted to study the impact of HBA1C on mean platelet volume and its with microvascular complication (retinopathy, neuropathy, nephropathy) in Type 2 diabetic patientsin western Rajasthan attending the Medicine Outdoor and indoor at M.D.M. Hospital Jodhpur.

Sample size

Sample size was calculated at alpha error 0.05 and study power 90% was calculated using the below formula for difference in two independent sample mean -

$$N = \frac{2\times\left(Z_{1-\alpha_2} + Z_{1-\beta}\right)^2 \times \sigma^2}{d^2}$$

Where,

N = Sample size $\left(Z_{1-\alpha_2}\right)$ = Standard normal deviate for Type 1 error (taken as 1.96 for 95% confidence interval)

$Z_{1-\beta}$ = Standard normal deviate for Type 2 error (taken as 1.28 for 90% study power)

σ = pooled standard deviation of mean platelet volume (taken as 2fl as per reference article)

d= minimum expected significant difference in diabetic patient and control group (taken as 1fl as per reference article)[9].

Sample size was calculated to be a minimum of 84 subjects in each group. Considering 10% attrition, sample size was enhanced and rounded of to 100 in each group

Duration of study: 8 months.

Inclusion criteria:1. all known cases of Diabetes Mellitus Type 2 diagnosed according to ADA criteria.

Exclusion criteria

1. Abnormal platelet count (<1.5lac or >4.5lac)
2. Use of drugs affecting platelet function (aspirin, warferin, ticagrelor, clopidogrel, or heparin.) and statin therapy
3. Pregnant females
4. Patients with known case of rheumatoid arthritis and SLE, Recent infection,Anemia (male Hb <12gm/dl and female Hb <10gm/dl,Type 1 DM and malignancy.

Methodology

The study included all individuals who were > 30 years of age. A verbal consent taken from all individuals entering in to the study. A written consent will be taking from all the individuals who undergo for height, weight, BMI was calculated by using formula ofWeight(kg)/Height^2(meter). Fasting blood glucose level and post prandial blood glucose level was detected by glucose oxidase method. Complete blood count done by collecting 2ml. blood sample in EDTA vial and process in SYSMEX 5 part auto analyzerand HbA1C testing had done by collecting 2ml of blood in EDTA vial and process by using high performance liquid chromatography of normal healthy individuals (control group) who attended OPD or attendants of indoor or outdoor patient and following all sampling criteria. A written consent was taken from all diabetic patients who underwent for height, weight, BMI, fasting blood

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glucose level, complete blood count and HbA1C testing of case group who attended OPD or indoor patients and following all sampling criteria[10].

Result and Observations

Table 1

Duration of DM (yrs)	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
≤5	30	60.00	19	38.00
6-10	20	40.00	24	48.00
>10	0	0.00	7	14.00
Total	50	100.00	50	100.00

Chi square 9.833, P value 0.007 (S)

Above table illustrates that most of the patients in case group A (HbA1c ≤7.5) had DMsince less than 5 years duration(60%) while in case group B (HbA1c > 7.5)most of patients had DM since6-10 years(48%).

Table 2

Duration of DM (yrs)	Mean platelet volume			p value
	No. of patients	Percentage	Mean+SD	
≤5	49	49.00	10.86+0.81	0.002
6-10	44	44.00	11.13+0.91	
>10	7	7.00	12.08+0.42	
Total	100	100.00	-	-

Table 3

Urine Dipstick test for protein	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Absent	38	76.00	26	52.00
Present	12	24.00	24	48.00
Total	50	100.00	50	100.00

Chi square 5.511, P value 0.018 (S)

This table show that urine dipstick test for protein show that proteinuria present in 52% diabetic patients in case group B while only 24% patients in case group A had proteinuria.

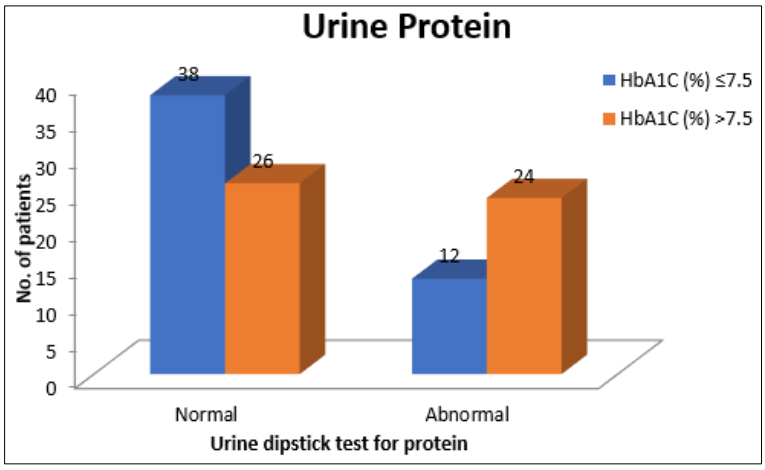

Fig 1: Urine Protein

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Table 4

Fundus examination (Diabetic retinopathy)	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Present	11	22.00	25	50.00
Absent	39	78.00	25	50.00
Total	50	100.00	50	100.00

Chi square 8.507, P value 0.003 (S)

This table show that on fundus examination diabetic retinopathy present in 50% patients in case group A while in case group B diabetic retinopathy present in only 22% patients.

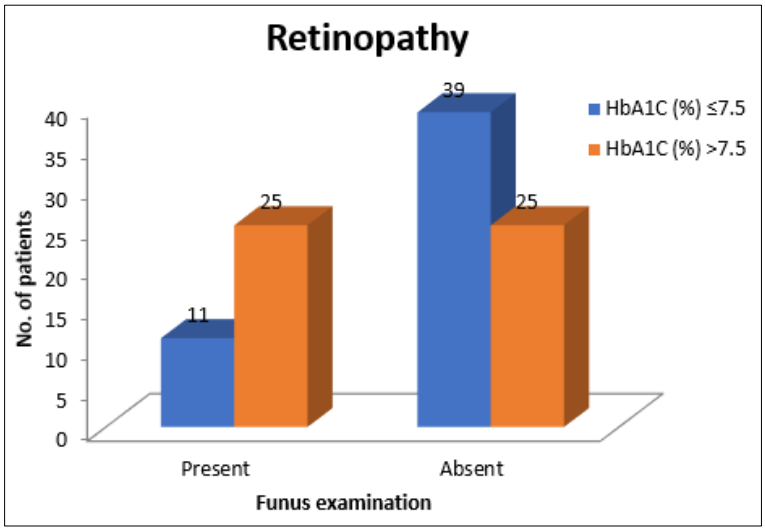

Fig 2: Retinopathy

Table 5

Fundus examination	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
NPDR	11	100.00	25	86.00
PDR	0	0.00	4	14.00
Total	11	100.00	29	100.00

Chi square 1.686, P value 0.194

Above table suggest that allpatients of case group A had only NPDRgrade of diabetic retinopathy while in case group B 86% patients had NPDR while 14% had PDR grade of diabetic retinopathy.

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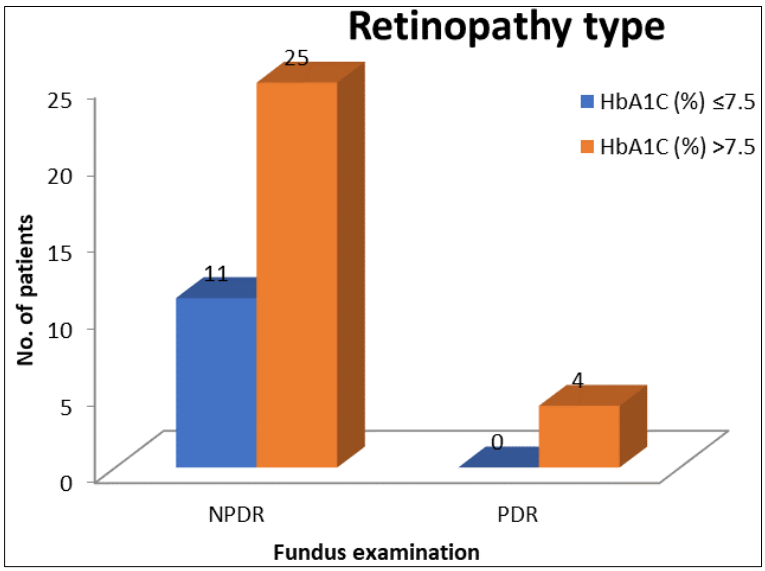

Fig 3: Retinopathy type

Table 6

NCV (F/S/O Peripheral neuropathy	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Present	18	36.00	27	54.00
Absent	32	64.00	23	46.00
Total	50	100.00	50	100.00

Chi square 3.273, P value 0.070

Above table show that peripheral neuropathy present in 36% patients in case group A while 54% patients in case group B had peripheral neuropathy on NCV examination.

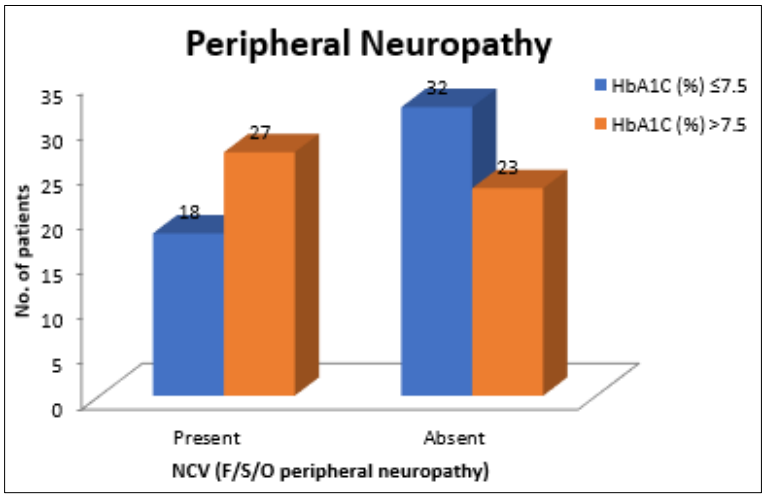

Fig 4: Peripheral Neuropathy

Table 7

Autonomic nervous system testing (ANST)	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Normal	37	74.00	28	56.00
Abnormal	13	26.00	22	44.00
Total	50	100.00	50	100.00

Chi square 3.560, P value 0.059

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Above table show that ANST dysfunction present in 26% patient of case group A while in case group B 44% patients had ANST dysfunction.

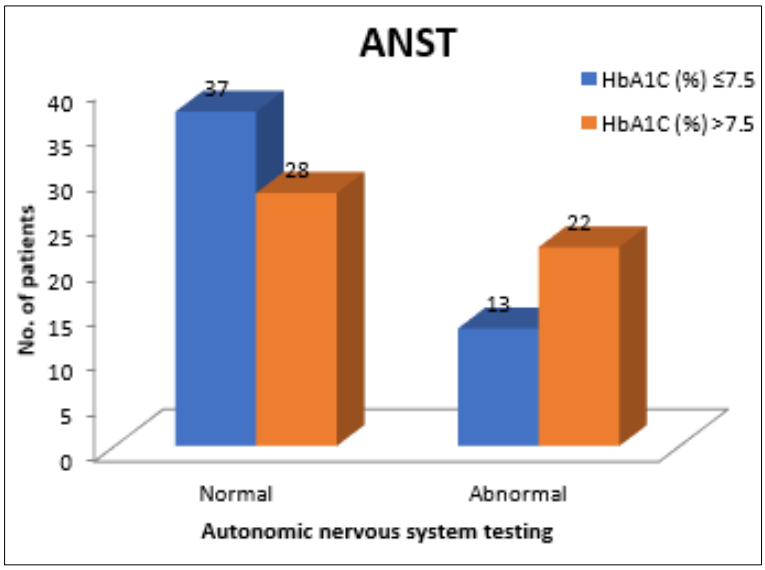

Fig 5: ANST

Table 8

Autonomic nervous system testing	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Mild abnormal	9	69.00	13	59.00
Moderate abnormal	4	31.00	8	36.00
Severe abnormal	0	0.00	1	5.00
Total	13	100.00	22	100.00

Chi square 0.799, P value 0.670

Above table suggest that in case group A9 patient (69%) had mild abnormality in ANST and4 patients (31%)had moderate abnormality in ANST in those patients had abnormal ANST.
This table also suggest that in case group B 59% patient had mild abnormality in ANSTand 36% patients had moderate abnormality in ANST while only1 patients (4%) had severe ANST dysfunction in those patients had abnormal ANST.

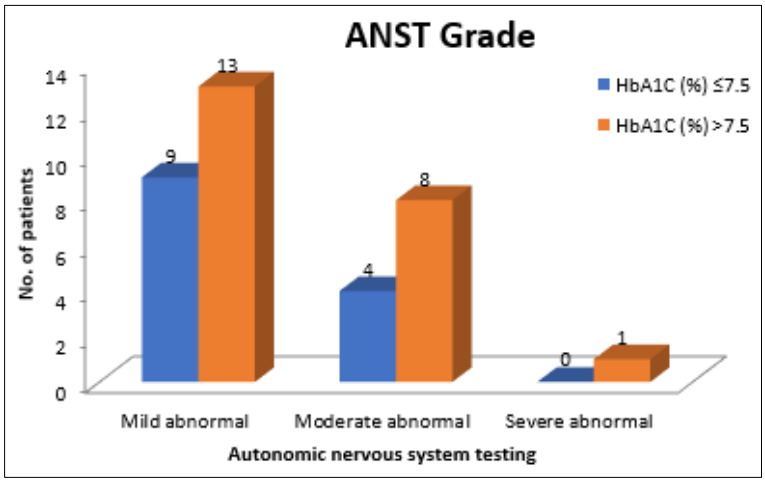

Fig 6: ANST Grade

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Table 9

Vibration perception testing	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Normal	32	64.00	24	48.00
Abnormal	18	36.00	26	52.00
Total	50	100.00	50	100.00

Chi square 2.597, P value 0.107

Above table suggest that vibration perception testing abnormal in 36% patients in case group A while in in case group B VPT is abnormal in 52% patients.

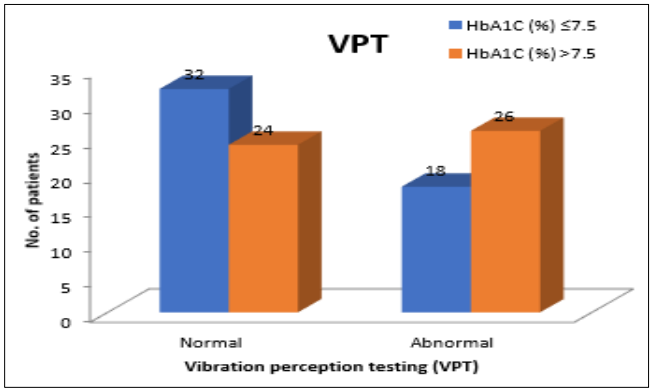

Fig 7: VPT

Table 10

Vibration perceptiontesting	HbA1C (%)			
	≤7.5		>7.5	
	N	%	N	%
Mild abnormal	10	56.00	11	42.00
Moderate abnormal	8	44.00	11	42.00
Severe abnormal	0	0.00	4	16.00
Total	18	100.00	26	100.00

Chi square 3.172, P value 0.204

This table suggest VPT is mild abnormal in 56% and moderate abnormal in 44% patients of case group A those had abnormal VPT.

In case group B 42% patients had mild and 42% had moderate abnormal VPT while only 4 patients (16%) had severe abnormal in those patients in which VPT is abnormal.

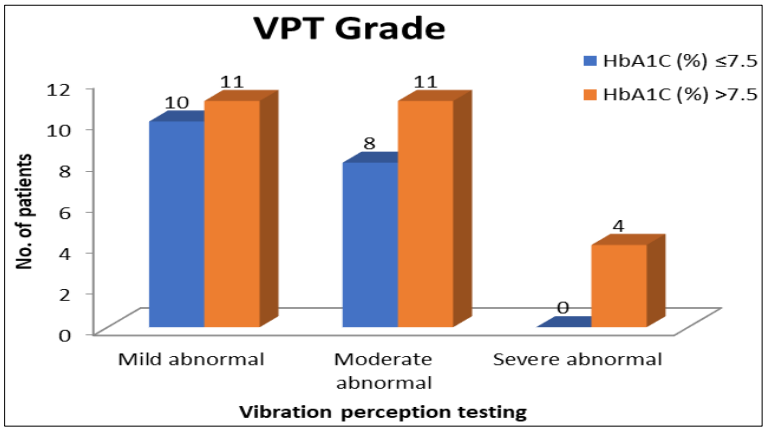

Fig 8: VPT Grade

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Table 11

Variables	HbA1C (%)				P value
	≤7.5		>7.5		
	Mean	SD	Mean	SD	
Age	57.26	11.67	58.28	11.80	0.609
Heart Rate (min)	80.16	5.48	76.60	4.01	0.0009
Weight (kg)	72.72	8.03	80.12	7.39	<0.0001
Height (cm)	169.52	6.84	169.48	6.67	0.876
BMI (kg/m2)	25.19	1.89	27.83	1.75	<0.0001
Haemoglobin	14.36	0.63	14.16	0.72	0.198
WBC	6989.80	1078.70	6244.40	1107.32	0.011
Platelet count (lac)	3.24	0.67	3.27	0.63	0.893
Mean platelet volume	10.44	0.71	11.71	0.52	<0.0001
Fasting blood glucose	127.70	8.92	180.26	20.58	<0.0001
HDL	43.02	2.89	42.66	4.55	0.427
LDL	108.70	27.16	119.76	23.33	0.005
VLDL	30.96	5.53	36.16	7.10	0.0004
Total cholesterol	182.68	26.15	198.58	24.77	0.0008
Serum triglyceride level	141.34	15.34	149.52	14.68	0.002
Duration of DM (yrs)	5.22	1.45	6.90	3.06	0.004

Above table contain different data comparisons between case group A and case group B.

Discussion

Diabetes mellitus is complex metabolic syndrome characterized by chronic hyperglycemia resulting in complications affecting the peripheral nerves, kidneys, eyes, and micro and macro vascular structures.The prevalence of diabetic microvascular complications is higher in people with poor glycemic control, longer duration of diabetes.[4]Mean Platelet Volume (MPV) is an indicator of the average size and activity of platelets[10, 11].

Younger platelet are larger and more reactive and aggregable. Hence, they contain denser granules, secrete more serotonin andβ-thromboglobulin, and produce more thromboxane A2 than smaller platelets[13,16].Hyperglycemia can increase platelet reactivity by inducing non enzymatic glycation of proteins on the surface of the platelet, by the osmotic effect of glucose and activation of protein kinase C.

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.

In our study, the mean platelet count is near similar in both case group A and B and mean platelet count not statistically different in between case and control group that was in contrast to Aclan Ozder and Manoj Saluja study which show higher platelet count in patient with poor glycemic control (high HBA1C). Hence, the platelet count could be dependent on several variables, that is mean platelet survival, platelet production rate, and turnover rate in DM.

Higher values of Mean Platelet Volume are observed in diabetic patients with microvascular complications such as retinopathy, neuropathy, and nephropathy. Higher values were also seen in studies done by Manoj Salujaand Ates *et al*. and papanas *et al*. and Aclan Ozder[12].

This suggested a role for the increased platelet activity in pathogenesis of micro vascular complication. In our study, MPV is significantly higher in diabetics with HbA1clevel >7.5% than in diabetics with HbA1c level < 7.5%. There was significant association between HbA1c and MPV, which was again seen in the studies done by Manoj Saluja, Aclan Ozder and Achana Buch. Many clinical trial results from the Diabetes Control and Coplications Trial (DCCT) and epidemiological data from the Wisconsin Epidemiological Study of Diabetic Retinopathy(WESDR) of have emphasized the strong relationship of glycemic control and development and progression of diabetic microvascular complication[13].

Therefore, it may be concluded that glycemic control decreases the hyper activity of the

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platelets function and thus may prevent or delay possible diabetic microvascular complications. However, our data needs to reconfirm in larger studies.

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