

Means  $\pm$  standard deviation (SD) and p value was calculated. Pearson's correlation coefficient was calculated. **Results:** Mean platelet count in cases and controls were 2.50 Lacs/cu.mm+/- 0.70 and 2.43+/- 0.77 (p value 0.53); MPV was 7.96+/- 1.12 (p value 0.06) and 7.64+/- 1.0; PDW was 11.92+/- 1.54 and 11.40+/- 1.33 (p value 0.02) respectively. There was positive correlation of MPV and PDW with Blood sugar fasting and HbA1c. r value for correlation of MPV with FBS and HbA1c were 0.1016 and 0.1145 respectively while that with PDW were 0.14 and 0.13 respectively.

Conclusion: We conclude that there is positive correlation between impaired glycemic control and derangement of platelet indices.

**KEYWORDS** : Platelet indices, Diabetes mellitus, Glycemic control, HbA1c

# INTRODUCTION

Diabetes Mellitus (DM) is the most challenging problem leading to global health crisis affecting 422 million people.<sup>1</sup> In India, 77million suffer from Diabetes in 2019. Government survey found 11.8% prevalence of diabetes in India.<sup>2</sup>

DM is a metabolic disorder characterised by chronic hyperglycemia which leads to long term macrovascular and microvascular complications involving kidneys, eyes and nerves.<sup>3</sup>

Platelets play a key role in the genesis of thrombosis and vascular complications of diabetes. Altered platelet morphology and function are observed in the diabetics. Larger platelets that contain denser granules are metabolically and enzymatically more active than smaller ones and have higher thrombotic potential. Altered platelet morphology is easily studied by Mean Platelet volume (MPV) and platelet distribution width (PDW) obtained by the automated analyser.<sup>3,4</sup>

Diabetic complications increases with poor glycemic control. Fasting blood glucose (BSF), postprandial blood glucose, and hemoglobin A1c (HbA1c) are widely used to monitor glycometabolic control in patients with DM. HbA1c is a more useful marker to determine mean blood glucose levels over a long time period.<sup>4</sup> In this study we aim to see the correlation of platelet indices with the glycemic control of the patients. Furthur we want to analyse whether BSF or HbA1C is a better analyser of platelet function.

#### **Materials and Methods**

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This was a cross sectional descriptive study conducted at a tertiary care hospital in Maharashtra. The study included total 150 patients, 74 diabetic patients and 66 nondiabetic control from the outpatient department of medicine over a period of 2 months. Institutional Ethical Committee clearance was obtained. Informed and written consent of the patients was taken.

We included diabetic patients diagnosed in accordance with the American Diabetes Association.<sup>5</sup> The control group was obtained from individuals without DM, as obtained from their medical records. Females with Hb <10 g% and males Hb <12 g%, nondiabetic subjects with coronary artery disease, malignancy, pregnant women, and patients on antiplatelet drugs were excluded from the study.

About 2 ml of blood was collected in EDTA, fluoride bulb, and plain bulb each. Complete hemogram was performed by using automatic blood counter Sysmex KX-21 from EDTA bulb. Hb, platelet count,

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MPV and PDW were recorded. BSF was measured by the glucose oxidase method. HbA1c level was analyzed by immunoturbidometric inhibition method.

Laboratory data of cases and controls included in the study was tabulated and analysed statistically using EPI INFO 7. The continuous variables were given as means  $\pm$  standard deviation (SD) and independent t test was applied. P value < 0.05 was considered statistically significant. Pearson's correlation coefficient was calculated for correlation of MPV and PDW with BSF and HbA1c. r value was obtained

#### **Results:**

A total of 74 diabetic patients (30 males, 44 females) and 66 controls (30 males, 36 females) were selected for the study. Mean age of cases was 51.29+/-18.46 years and that of controls was 41.19+/-14.39. with p value of 0.00025.

Mean BSF for cases and controls was 133.81 mg/dl +/- 37.32 and 88.33 mg/dl +/- 16.03 . Mean HbA1c of cases and controls was 5.9 %+/- 1.01 and 4.9 % +/- 0.58 respectively.

The mean of platelet indices in the cases and controls are as shown in Table I.

# Table I: Comparison of platelet count and indices in case and control group

Parameters	Normal Value	Case (n=300)		Control (n=200)		P Value
		Mean	SD	Mean	SD	
Platelet count (Lac/cmm)	1.5 – 4.5 lac/cmm	2.50	0.70	2.43	0.77	0.53
MPV (fl)	6.5 – 12 fl	7.96	1.12	7.64	1.00	0.06
PDW (fl)	9 – 17 fl	11.92	1.54	11.40	1.33	0.02

We observed increased platelet count, MPV and PDW in cases of diabetes than control. However, it was not statistically significant for platelet count and MPV. PDW was significantly increased in diabetics.

BSF and HbA1c levels of all cases and control were correlated with MPV and PDW to ascertain the effect of glycemic control on platelet indices. r value for correlation of BSF with MPV and PDW was 0.1016 and 0.14 respectively. Correlation of HbA1c with MPV and PDW are shown in Figure 1,2. Both BSF and HbA1c showed positive correlation with platelet indices MPV and PDW with no significant difference between BSF and HbA1c.

#### Figure 1 Linear Regression and Correlation between HbA1c and MPV



r value : 0.1145

# Figure 2 Linear Regression and Correlation of BETWEEN HbA1c and PDW



r value 0.13

# **DISCUSSION:**

Diabetes is a growing health problem associated with increased morbidity due to micro and macro-vascular complications.<sup>6</sup> Previous studies have suggested that platelet indices are useful to predict the vascular complications in diabetes.7 Immediate and long term glycemic controls can be easily detected by BSF and HbA1c. Good glycemic control has shown to decrease the severity of morbidity and mortality.8 HbA1c gives longterm glycemic control, however it is found that there may be marked variation in the blood sugar levels with controlled HbA1c value. Fluctuation in the daily sugar values are also considered harmful and may be the cause of complications. Hence we intend to correlate MPV and PDW with glycemic control in terms of both, BSF and HbA1c.

Diabetes is a disease of vessels causing prothrombotic state, accompanied by inflammation and accelerated atherosclerosis. Immature and large platelets play an important role in the pathogenesis and complications of diabetes. Platelet indices like MPV and PDW are the early markers to identify platelet dysfunction in diabetic patients.9

Our study revealed high platelet count in diabetics as compared to controls. Many other authors had similar findings.<sup>4,9,10</sup> However few studies revealed decrease in the platelet count in diabetics than controls.<sup>11,12</sup> Increased platelet count can be due to increased production due to hyperglycemia.1

We found increase in MPV and PDW in diabetics as compared to controls. This can be explained by releases of platelets from the bone marrow during hyperglycemia. These younger platelets are larger in size and are functionally active due to increased GP II b/IIIa, GP Ib-IX, GPIa/IIa and CD62. This may give rise to increase in MPV. The large reticulated platelets which are activated are different in size than nonactivated ones because of pseudopodia formation and change in shape from discoid to spherical giving rise to increased PDW.

Various studies have shown that MPV was in normal range in diabetics but PDW and PLCR were higher.<sup>4,15</sup> This could be explained by the fact that PDW and PLCR are independent of platelet count where as MPV is dependent on platelet count or platelet crit and is calculated by histogram. We had MPV and PDW both within normal range, though

the means of MPV and PDW were higher in cases as compared to control group. Thus, correlating these platelet indices with glycemic control can be used to predict diabetic complications.

Our study revealed positive correlation of MPV and PDW with glycemic control measured by BSF and HbA1c. We did not find any significant variation in either of platelet indices like MPV and PDW with BSF and HbA1c. Alhadas KR et al showed higher PDW in diabetics with complications and found a positive correlation between BSF and PDW in diabetics; between HbA1c and PDW as well as MPV and PCT. These changes were attributed to the osmotic effect due to hyperglycemia and some of its metabolites in blood.<sup>1</sup>

Hekimsoy Z, et al did not find a significant correlation in MPV versus BSF.16 Some studies have reported positive association of MPV with elevated BSF and HbA1c levels.<sup>9,10</sup> However, it is proposed that BSF is not directly associated with increased cardiovascular events in patients with type 2 DM.<sup>1</sup>

The limitations of our study were low sample size and inability to include PLCR as this was a short term student project of 2 months duration. Long term study with larger sample size including cases with and without complications including all platelet indices will be planned for future.

#### **CONCLUSION:**

We conclude that there is positive correlation between impaired glycemic control and derangement of platelet indices. Platelet indices can be used as an early, easy and inexpensive predictive marker for impaired glycemic control leading to diabetic complications.

# **REFERENCES:**

- Colin D Mathers, Dejan Loncar. Public Library of Science PLOS Medicine Projections 1. of Global Mortality and Burden of Disease from 2002 to 2030 Published: November 28, 2006. Available at: https://doi.org/10.1371/journal.pmed.0030442.
- World Health Organization (WHO) Diabetes WHO Fact sheet Updated 30 October 2. 2018 available at: https://www.who.int/news-room/fact-sheets/detail/diabetes. Zuberi BF, Akhtar N, Afsar S. Comparison of mean platelet volume in patients with 3
- diabetes mellitus impaired fasting glucose and non diabetic subjects. Singapore Med J. 2008:49(2):114-116
- Buch A, Kaur S, Nair R, Jain A. Platelet volume indices as predictive biomarkers for 4 diabetic complications in Type 2 diabetic patients. J Lab Physicians 2017;9:84-8
- 5. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2004:27:5-10.
- Dindar S, Cinemre H, Sengul E, Annakkaya AN. Mean platelet volume is associated 6 with glycaemic control and retinopathy in patients with type 2 diabetes mellitus. West Indian Med J 2013;62:519-23
- Demirtas L, Degirmenci H, Akbas EM, Ozcicek A, Timuroglu A, Gurel A, et al. Association of hematological indicies with diabetes, impaired glucose regulation and microvascular complications of diabetes. Int J Clin Exp Med 2015;8(7):11420–7. 7.
- Stratton IM, Adler AI, Neil HAW Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational 8. study. BMJ 2000;321:405–412 Kodiatte TA, Manikyam UK, Rao SB, Jagadish TM, Reddy M, Lingaiah HM, et al.
- 9 Mean platelet volume in type 2 diabetes mellitus. J Lab Physicians 2012;4:5-9. Alhadas KR, Santos SN, Freitas MM, Viana SM, Ribeiro LC, Costa MB. Are platelet 10.
- indices useful in the evaluation of type 2 diabetic patients? J Bras Pathol Med Lab 2016:52:96-102
- Demirtunc R, Duman D, Basar M, Bilgi M, Teomete M, Garip T. The relationship between glycemic control and platelet activity in type 2 diabetes mellitus. J Diabetes Complications. 2009;23:89-94
- Kshirsagar RM, Deoke S, Akhtar S Platelet indices in type 2 diabetes mellitus and their association with microvascular complications Panacea Journal of Medical Sciences 201 9;9(1):23
- 13.
- Schneider DJ Factors Contributing to Increased Platelet Reactivity in People With Diabetes, Diabetes Care. 2009; 32(4): 525–527. doi: 10.2337/dc08-1865 Vagdatli E, Gounari E, Lazaridou E, Katsibourlia E, Tsikopoulou F, Labrianou I. Platelet distribution width: a simple, practical and specific marker of activation of coagulation. 14 Hippokratia 2010;14(1):28-32
- Kodiatte TA, Manikyam UK, Rao SB, Jagadish TM, Reddy M, Lingaiah HM, 15. Lashmaiah V. Mean platelet volume in type 2 diabetes mellitus. J Lab Pysician. 2012:4:5-9
- Hekimsoy Z, Payzin B, Ornek T, Kandoğan G. Mean platelet volume in type 2 diabetic 16. patients. Diabetes Complications 2004;18(3):173-6. Yeboah J, Bertoni AG, Herrington DM, Post WS, Burke GL. Impaired fasting glucose
- 17 and the risk of incident diabetes mellitus and cardiovascular events in an adult oopulation: MESA (Multi-Ethnic Study of Atherosclerosis). J Am Coll Cardiol 2011;58:140-6.

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