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TYPE 2 DIABETES MELLITUS PATIENTS' MEAN PLATELET VOLUME, GLYCEMIC CONTROL, AND VASCULAR COMPLICATIONS: A PROSPECTIVE STUDY

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ABSTRACT –

Introduction: Platelet dysfunction is a major systemic consequence of Diabetes mellitus (DM), a health issue with a rising prevalence that affects people all over the world.

Methodology: 120 individuals with Type 2 Diabetes Mellitus were separated into groups with and without vascular issues for the research. In accordance with recognized DM diagnostic criteria, we evaluated a number of variables, including Plateletcrit (PCT), mean platelet volume (MPV), platelet distribution width (PDW), and blood glucose levels. Strict inclusion/exclusion criteria and ethical guidelines were meticulously followed during data collection.

Results: Patients with vascular problems had raised MPV, PDW, and PCT as well as noticeably higher blood glucose levels. Notably, in diabetics with vascular problems, MPV showed a high favourable connection with glycaemic control indicators.

Conclusion: In conclusion, our research emphasizes possible significance of MPV as a marker for identifying and treating DM-related vascular problems. This finding is clinically significant for improving diabetes control.

Keywords: Vascular problems, Diabetes Mellitus, Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), and Plateletcrit (PCT).

INTRODUCTION -

A complicated group of metabolic illnesses known as diabetes mellitus (DM) are defined by high blood glucose levels, or hyperglycaemia. There are numerous mechanisms that

contribute to hyperglycaemia in people with diabetes, including the pancreas' decreased secretion of insulin, cells' impaired uptake of glucose, and the liver's increased synthesis of glucose. Due to its wide-ranging effects on numerous organ systems, this metabolic dysfunction not only affects people with diabetes but also places a huge burden on healthcare systems around the world.

Recently, diabetes has been acknowledged as a severe worldwide health concern. The International Federation of Diabetes (IDF) has issued concerning reports of a substantial and alarming rise in the number of adults worldwide living with diabetes. According to their latest data, there are now 537 million adults affected by diabetes, marking a 16% increase (equivalent to 74 million more cases) compared to estimates from 2019. According to projections, this number will rise to 629 million people worldwide by 2045, with a substantial portion of this burden falling on South East Asia, where a staggering 151 million people are projected to be affected. It is noteworthy that a substantial 77% of the global diabetes burden is expected to weigh on emerging countries in the 21st century, and India, in particular, reports a prevalence rate of 8.8% (Tönnies et al., 2021).

Hyperglycaemia, the hallmark of diabetes, sets the stage for a range of chronic systemic complications. These complications have profound implications for both affected individuals and society as a whole, often striking people when they were at their most productive. The adverse effects of hyperglycaemia are typically categorized into two main groups:

Macrovascular complications: These include conditions such as Peripheral artery disease, cerebrovascular accident (commonly known as stroke), and coronary artery disease, all of which affect large blood vessels and can lead to severe cardiovascular problems.

Microvascular complications: They include diabetes retinopathy, which affects the eyes, diabetic nephropathy, which affects the kidneys, and diabetic neuropathy, which affects the nerves. These complications predominantly affect smaller blood vessels and can result in significant health issues (Fowler, 2008).

Notably, in people with diabetes, platelet dysfunction is a critical factor in the emergence of both microvascular and macrovascular disorders. Platelet function and structure have changed as a result of extended exposure to hyperglycaemia and insulin resistance, which is the cause of this dysfunction. These changes can lead to damage in the pericytes (cells surrounding small blood vessels) and endothelium (the inner lining of blood vessels). The prothrombotic (clot-promoting) status of platelets is believed that a distinguishing feature of Diabetes Mellitus, vascular complications, plays a part in this metabolic condition. (Buch et al., 2017).

Platelet indices serve as valuable functional indicators of the body's homeostasis because platelets essential part in preserving the vascular system's integrity. Larger platelets, characterized by their increased content of dense granules, are more potent and have a higher thrombotic (blood clotting) potential. This prothrombotic state has been associated with conditions like Type 2 diabetes, the metabolic syndrome, strokes, coronary artery disease, and high mean platelet volume (MPV). Some studies even suggest that platelet indices are notably higher in diabetes mellitus patients compared to those without the condition, further underlining the importance of platelet function in diabetes-related complications (Zuberi et al., 2008, Khandekar, 2006).

The diabetes-related long-term complications are a primary cause of mortality and a significant contributor to a reduced quality of life for affected individuals. These complications are closely linked to endothelial dysfunction, primarily driven by inadequate glycaemic management (poor blood sugar control) (Arora et al., 2009). Although early detection of these problems remains difficult, emerging research suggests that platelets are one of the components of the blood clotting system that cause the emergence of certain health problems. This underscores the potential usefulness of platelet-related parameters in evaluating and managing the complications associated with diabetes (Corash et al., 1987, Pereira et al., 1988).

Utilizing blood cell counters, recent developments in laboratory technology have made it possible to evaluate numerous platelet properties. Examples of these parameters are Platelet large cell ratio (P-LCR), platelet crit (PCT), and platelet distribution width (PDW), and MPV (Ismail et al., 2009). By analysing these platelet parameters, contemporary haematological analysers may quickly determine the prothrombotic condition of platelets, providing a potential route for early intervention and monitoring in the treatment of diabetes (Pereira et al., 1988).

The current study's objective is to assess how platelet function affects those with Type 2 Diabetes Mellitus, examining mean platelet volumes in both those with and without vascular problems. Creating more efficient prevention and treatment plans for this global health issue requires an understanding of the role played by platelets in issues associated with diabetes.

MATERIALS AND METHODOLOGY –

At Krishna Hospital, a hospital-based prospective, single-center, cross-sectional study was done in the hospital wards and intensive care unit. The research will last 18 months, starting in January 2021 and ending in June 2022. The study is carried out in a teaching facility and tertiary care hospital located in a major city in Western Maharashtra.

The study encompasses a total of 120 participants, with an equal distribution of 60 individuals in each of the comparative groups. The study involves patients who either visit the Medicine Department OPD or are admitted to the wards of the Medicine Department at Krishna Hospital, which is a tertiary care healthcare facility and a teaching institution located in a metropolitan city in Western Maharashtra. Following a detailed review of the study procedure, the institutional ethics committee gave the study their seal of approval.

The inclusion criteria for this study comprise two groups: Group A consists of patients who have a confirmed diagnosis of diabetes along with concurrent vascular complications, while Group B includes patients with a confirmed diabetes diagnosis but without vascular complications. On the other hand, the exclusion criteria encompass several conditions. Patients who are male and have haemoglobin levels below 13 mg/dL or below 12 mg/dL in females were not be eligible for participation. Additionally, individuals with diabetes who are currently on anti-platelet medications or antibiotics known to induce low platelet counts (thrombocytopenia) was excluded from the study. Patients experiencing fever (pyrexia) were also not part of the study, and gestational diabetes patients are not included. Furthermore, individuals with cirrhosis of the liver and those with a documented history of malignancy will be excluded from participating in the study.

The diagnosis of diabetes mellitus relies on specific criteria. First, it is shown when people have symptoms of diabetes and their Random Blood Sugar (RBS) levels are higher than 200

mg/dL. A diagnosis is also made if the Fasting Blood Sugar (FBS) levels are higher than 126 mg/dL or if their Haemoglobin A1c (HbA1c) levels exceed 6.5%. Additionally, diabetes is identified if a glucose tolerance test results in 2-hour plasma glucose levels that are higher than 200 mg/dL. In addition to these requirements, diabetes-related symptoms such excessive thirst, blurred vision, tingling or numbness in the limbs, non-healing wounds, reoccurring yeast infections, increased appetite, frequent urination, and unexplained weight gain are also necessary.

Tool for Data Collection:

If 2-hour plasma glucose levels during a glucose tolerance test are more than 200 mg/dL, diabetes is diagnosed. Diabetes is characterized by a number of usual symptoms in addition to these requirements, including excessive thirst, blurred vision, tingling or numbness in the extremities, non-healing wounds, recurring yeast infections, increased hunger, frequent urination, and unexplained weight gain. The patient's height, weight, and Body Mass Index (BMI) are all included in this. A Complete Blood Count (CBC), Mean Platelet Volume (MPV), Fasting Blood Sugar (FBS), Post-Prandial (PP) Blood Sugar levels, Haemoglobin A1c (HbA1c) values, and platelet counts are other essential data variables included in our study.

In terms of the data collecting procedure, it starts after receiving ethical permission from the KIMS Institutional Ethics Committee and obtaining informed consent from everyone who would be taking part. To guarantee the accuracy and applicability of the information acquired, data collection rigorously complies with the predetermined inclusion and exclusion criteria.

Statistical Analysis:

Data gathered is inputted into Microsoft Excel and subjected to analysis using suitable statistical techniques. Categorical data is presented quantitative data which are evaluated by computing their mean and standard deviation, whereas qualitative variables are expressed in frequencies and percentages. When applicable, the student's t-test and the chi-square test are used to analyze comparisons. The relationships between platelet indices and variables including Fasting Blood Sugar (FBS), Post-Prandial Blood Sugar (PPBS), and HbA1c are examined using Pearson's correlation. In terms of statistics, significance is determined when the p-value is 0.05 or less.

RESULTS –

120 patients with Type 2 diabetes were included in the study and divided into two groups: Group A included those with Type 2 diabetes with associated vascular problems, and Group B, encompassing those with Type 2 diabetes but without vascular problems.

Upon examining the age distribution, it was discovered that Group A had five patients aged 40 to 50, 19 patients aged 51 to 60, 23 patients aged 61 to 70, and eight patients over 70 years old. In Group B, there were 11 patients aged 40 to 50, 22 patients aged 51 to 60, 28 patients aged 61 to 70, and four patients over 70 years old. The average age in Group A was 62.35 years, while in Group B, it was 61.12 years.

Group A exhibited a male-to-female ratio of about 1.07:1, with 31 male patients and 29 female patients. Group B had a higher male-to-female ratio of nearly 1.73:1, with 38 males (63.33%) and 22 females (36.67%).

Concerning the duration of diabetes, Group A consisted of 7 patients with 0 to 5 years of diabetes history, 31 patients with 6 to 10 years, and 22 patients with over 10 years. In contrast, Group B included 11 patients with 0 to 5 years, 34 patients with 6 to 10 years, and 15 patients with over 10 years of diabetes. Significantly, Group A had a notably longer average diabetes duration of 8.54 years, while Group B had a shorter duration averaging 5.46 years.

In terms of blood sugar levels, Group A had an average fasting blood sugar level of 193.6 mg/dL, which was markedly higher than the mean level of 112.65 mg/dL in Group B. Likewise, Group A's mean post-meal blood sugar level was 239.56 mg/dL which was substantially higher than the level of 161.35 mg/dL in Group B. These results demonstrate that individuals with Type 2 diabetes and vascular complications experienced significantly elevated fasting and postprandial blood sugar levels compared to those without vascular issues, as listed in table 1.

Table 1: Examining the average mean and standard deviation of numerical variables within the population, we conducted this comparison for two distinct groups:

Patients with diabetes mellitus and vascular complications (Group A) and Patients with diabetes mellitus but without any vascular complications (Group B).

Numerical variables	**Group A**	**Group B**
Body Mass Index (BMI)	26.59 (± 8.34)	25.42 (± 7.89)
Duration of Diabetes mellitus	8.54 (± 2.83)	5.46 (± 2.38)
Fasting Blood Sugar (FBS)	193.6 (±105.28)	112.65 (± 70.98)
Postprandial Blood Sugar (PPBS)	239.56 (± 121.14)	161.35 (± 72.07)
HbA1c	8.12 (± 2.36)	6.92 (± 1.45)
Mean Platelet Volume (MPV)	11.17 (± 2.12)	10.01 (± 1.83)
Platelet Distribution Width	11.86 (± 2.83)	10.77 (± 1.47)
Plateletcrit	0.267 (± 0.15)	0.131 ± (0.15)

The study showed that patients in Group A, who suffered from both Type 2 Diabetes Mellitus and concurrent vascular complications, had an average HbA1c level of 8.12. In comparison, Group B patients, who did not have vascular issues, had an average HbA1c level of 6.92. Patients with Type 2 Diabetes Mellitus and vascular problems had significantly higher HbA1c levels (p-value < 0.001). When it came to mean platelet volume (MPV), Group A had an average MPV of 11.17, while Group B had an average of 10.01. Individuals with Type 2 diabetes and vascular complications displayed notably higher mean platelet volumes, supported by a p-value of 0.001.

Regarding Platelet Distribution Width (PDW), Group A had an average PDW level of 11.86, whereas Group B had a level of 10.77. Remarkably, patients with Type 2 Diabetes Mellitus and vascular complications exhibited higher Platelet Distribution Width values. Finally, Group A showed an average Plateletcrit (PCT) level of 0.267, whereas Group B had an average PCT level of 0.131. Plateletcrit levels were significantly higher in patients with Type 2 Diabetes Mellitus and vascular problems (p-value 0.001).

The study also revealed weak positive connections between MPV and various factors in the sample of Type 2 Diabetes Mellitus patients with vascular problems. A robust positive correlation (p-value 0.001) was identified between MPV and HbA1c levels, fasting blood sugar levels, and post-meal blood sugar levels. Additionally, within the overall research group, MPV showed a slightly positive correlation with HbA1c, Fasting Blood Sugar, and Post-Prandial Blood Sugar in Group A, and a similar marginal positive correlation in Group B, respectively, depicted in table 2, 3 and 4.

Table 2: Correlation of MPV and HbA1c in those with vascular problems associated with type 2 diabetes

Relationship between Mean Platelet Volume (MPV) and Hemoglobin A1c (HbA1c).		MPV
HbA1c	Pearson Correlation (r)	0.303
	Sig. (2 tailed) (p)	<0.001
	n	60

Table 3: Correlation between Mean Platelet Volume (MPV) and Fasting Blood Sugar (FBS) in individuals diagnosed with Type 2 Diabetes Mellitus and experiencing vascular complications.

Correlation between MPV and FBS		MPV
Fasting Blood Sugar	Pearson Correlation (r)	0.390
	Sig. (2 tailed) (p)	<0.001
	n	60

Table 4: Correlation between Mean Platelet Volume (MPV) and Post-Prandial Blood Sugar (PPBS) in individuals diagnosed with Type 2 Diabetes Mellitus and suffering from vascular complications

Correlation between MPV and PPBS		MPV
	Pearson Correlation (r)	0.314

Post Prandial Blood Sugar	Sig. (2 tailed) (p)	<0.001
	n	60

DISCUSSION –

In this prospective study, our aim was to explore the connection between mean platelet volume (MPV) and vascular complications in individuals diagnosed with Type 2 diabetes mellitus (Type 2 DM). The research focused on patients with Type 2 DM and concurrent vascular issues, including conditions like coronary artery disease, cerebrovascular incidents, and diabetic retinopathy. These patients were divided into two groups and studied in both the intensive care unit (ICU) and medical wards of a tertiary care hospital. Based on strict HbA1c, Random Blood Sugar, or Fasting Blood Sugar criteria established by the American Diabetes Association (ADA) for the diagnosis of diabetes mellitus, participants were chosen from those who were hospitalized or visited the outpatient department between January 2021 and June 2022.

Our study compared those with and without vascular problems in order to better understand how platelet function affects those with Type 2 DM. We chose 60 people with Type 2 DM and vascular problems at random. The average ages of the two groups—those with vascular issues and those without—were comparable, showing that there was little age difference between them. According to earlier studies, people with diabetes mellitus are frequently between the ages of 60 and 70.

In terms of gender distribution, our research identified no appreciable differences between the two groups, which is in line with earlier work by AV Gupta et al. Additionally, both post-prandial and fasting blood sugar levels as well as HbA1c readings showed significant variations between the groups in our analyses. According to prior research by R. S. Walinjkar et al. and K. J. Brahmbhatt et al., patients with vascular problems and diabetes mellitus tend to have higher blood sugar levels.

Furthermore, our study highlighted notable differences in platelet indices between the two groups. Patients with vascular complications exhibited higher mean MPV, Platelet Distribution Width (PDW), and Plateletcrit (PCT) levels compared to those without complications. These findings were in harmony with previous research indicating elevated MPV, PDW, and PCT values in Type 2 DM patients.

Additionally, our study established strong positive correlations between MPV and crucial variables such as Fasting Blood Sugar, Postprandial Blood Sugar, and HbA1c levels in Type 2 DM patients with vascular complications (Group A). Similar significant positive relationships were observed for PDW and these glycaemic indicators in Group A.

However, it's vital to acknowledge the study's limitations. The relatively small sample size of 120 participants, the cross-sectional design preventing causal inferences, and potential confounding variables such as medication and lifestyle factors must be considered. The clinical significance of the observed correlations between MPV and glycaemic indicators requires further exploration. Conducting larger prospective studies addressing these limitations would enhance our understanding of the relationship between MPV and vascular complications in Type 2 DM.

CONCLUSION –

In our study, we discovered that the mean platelet volume (MPV) and platelet distribution width (PDW) were significantly greater in individuals with diabetes mellitus who also had vascular issues. Additionally, in diabetic patients with vascular problems, we found a robust and statistically significant positive relationship between MPV and important glycaemic markers such fasting blood sugar, postprandial blood sugar, and HbA1c. This suggests that MPV and glycaemic parameters are closely associated in diabetics with vascular issues.

REFERENCES –

Alhadas, K. R., Santos, S. N., Freitas, M. M. S., Viana, S. M. S. A., Ribeiro, L. C., & Costa, M. B. (2016). Are platelet indices useful in the evaluation of type 2 diabetic patients? Jornal Brasileiro De Patologia E Medicina Laboratorial. https://doi.org/10.5935/1676-2444.20160017

Amer, H. M., Makboul, K. M., Mostafa, B. M., Girgis, C. A., & Mohammed, Y. A. (2020, March 1). The study of Mean Platelet Volume (MPV) as a Potential Risk Factor for Macrovascular Complications (Ischemic Heart Disease and Cerebrovascular Stroke) in Type 2 Diabetes Mellitus. QJM: An International Journal of Medicine, 113(Supplement_1). https://doi.org/10.1093/qjmed/hcaa052.024

Arora, S., Ojha, S. K., & Vohora, D. (2009). Characterisation of streptozotocin induced diabetes mellitus in swiss albino mice. Global Journal of Pharmacology, 3(2), 81-84. Jindal, S., Gupta, S., Gupta, R., Kakkar, A., Singh, H. V., Gupta, K., & Singh, S. (2011, March). Platelet indices in diabetes mellitus: indicators of diabetic microvascular complications. Hematology, 16(2), 86–89. https://doi.org/10.1179/102453311x12902908412110

Brahmbhatt, K. J., Chaudhary, B., Raval, D. M., Mallik, S., Khan, S., Patel, M., & Patel, N. (2022, September 19). Association of Mean Platelet Volume With Vascular Complications in the Patients With Type 2 Diabetes Mellitus. Cureus. https://doi.org/10.7759/cureus.29316

Buch, A., Kaur, S., Nair, R., & Jain, A. (2017, April). Platelet volume indices as predictive biomarkers for diabetic complications in Type 2 diabetic patients. Journal of Laboratory Physicians, 9(02), 084–088. https://doi.org/10.4103/0974-2727.199625

Cadirci, K., Olcaysu, O., Yigit, D., Carlioglu, A., & Durmaz, D. S. A. (2014, April 17). Mean platelet volume in type 2 diabetic patient: is there a relationship between mean platelet volume and diabetic microvasculary complications? Endocrine Abstracts. https://doi.org/10.1530/endoabs.35.p448

Citirik, M., Beyazyildiz, E., Simsek, M., Beyazyildiz, O., & Haznedaroglu, I. C. (2014, December 19). MPV may reflect subcinical platelet activation in diabetic patients with and without diabetic retinopathy. Eye, 29(3), 376–379. https://doi.org/10.1038/eye.2014.298

Corash, L., Chen, H., Levin, J., Baker, G., Lu, H., & Mok, Y. (1987, July 1). Regulation of thrombopoiesis: effects of the degree of thrombocytopenia on megakaryocyte ploidy and platelet volume. Blood, 70(1), 177–185. https://doi.org/10.1182/blood.v70.1.177.bloodjournal701177

Demirtunc, R., Duman, D., Basar, M., Bilgi, M., Teomete, M., & Garip, T. (2009, March). The relationship between glycemic control and platelet activity in type 2 diabetes mellitus. Journal of Diabetes and Its Complications, 23(2), 89–94. https://doi.org/10.1016/j.jdiacomp.2008.01.006

Fowler, M. J. (2008, April 1). Microvascular and Macrovascular Complications of Diabetes. Clinical Diabetes, 26(2), 77–82. https://doi.org/10.2337/diaclin.26.2.77

Gupta, A. V., Gupta, A. V., & Mukherji, A. (2016). Platelet Indices and Endothelial Dysfunction in Patients of Diabetes Mellitus Type 2. Sch J App Med Sci, 4(3D), 877-86.

Hekimsoy, Z., Payzin, B., Örnek, T., & Kandoğan, G. (2004, May). Mean platelet volume in Type 2 diabetic patients. Journal of Diabetes and Its Complications, 18(3), 173–176. https://doi.org/10.1016/s1056-8727(02)00282-9

Ismail, M. Y. M., & Yaheya, M. (2009). Clinical evaluation of antidiabetic activity of Trigonella seeds and Aegle marmelos leaves. World Applied Sciences Journal, 7(10), 1231-1234.

Ji, S., Zhang, J., Fan, X., Wang, X., Ning, X., Zhang, B., Shi, H., & Yan, H. (2019, March 12). The relationship between mean platelet volume and diabetic retinopathy: a systematic review and meta-analysis. Diabetology & Metabolic Syndrome, 11(1). https://doi.org/10.1186/s13098-019-0420-3

Khandekar, M. M. (2006, February 1). Platelet volume indices in patients with coronary artery disease and acute myocardial infarction: an Indian scenario. Journal of Clinical Pathology, 59(2), 146–149. https://doi.org/10.1136/jcp.2004.025387

Kodiatte, T. A., Manikyam, U. K., Rao, S. B., Jagadish, T. M., Reddy, M., Lingaiah, H. K. M., & Lakshmaiah, V. (2012, January). Mean Platelet Volume in Type 2 Diabetes Mellitus. Journal of Laboratory Physicians, 4(01), 005–009. https://doi.org/10.4103/0974-2727.98662

Kumar, S., Walinjkar, R., Khadse, S., Bawankule, S., & Acharya, S. (2019). Platelet Indices as a Predictor of Microvascular Complications in Type 2 Diabetes. Indian Journal of Endocrinology and Metabolism, 23(2), 206. https://doi.org/10.4103/ijem.ijem_13_19

Pereira, J., Cretney, C., & Aster, R. H. (1988). Variation of class I HLA antigen expression among platelet density cohorts: a possible index of platelet age?.

Tabish SA. Is diabetes becoming the biggest epidemic of the twenty-firstcentury? Int J Health Sci (Qassim) 2007;1:V-VIII.

Tönnies, T., Rathmann, W., Hoyer, A., Brinks, R., & Kuss, O. (2021, August). Quantifying the underestimation of projected global diabetes prevalence by the International Diabetes Federation (IDF) Diabetes Atlas. BMJ Open Diabetes Research & Care, 9(1), e002122. https://doi.org/10.1136/bmjdrc-2021-002122

Zuberi, B. F., Akhtar, N., & Afsar, S. (2008). Comparison of mean platelet volume in patients with diabetes mellitus, impaired fasting glucose and non-diabetic subjects. Singapore medical journal, 49(2), 114.