

The Relationship between Mean Platelet Volume and HbA1c in Patients with Diabetes Mellitus: A Controversial Topic

Athena D. Myrou*, Styliani A. Spanou, Christina P. Michael, Maria C. Christodoulou and Christos G. Savopoulos

Department of Internal Medicine, University General Hospital AHEPA, Thessaloniki, Greece

Abstract

This text pertains to the connection between Mean Platelet Volume (MPV) and diabetes mellitus, a widespread health issue. Elevated MPV levels have been linked to various diseases, including cardiovascular diseases and diabetes-related complications. Research has shown that MPV levels are higher in patients with uncontrolled diabetes than in those with controlled diabetes; multiple theories have been proposed to explain this observation. The relationship between MPV and glycated hemoglobin (HbA1c) levels is a subject of debate, with some studies showing no association, while others have demonstrated a correlation between the two. The scientific community has focused on investigating MPV as an inflammatory marker of diabetes mellitus and obesity. MPV may serve as a useful diagnostic tool for detecting thrombotic complications in conjunction with Platelet Distribution Width (PDW). Elevated MPV levels have also been associated with an increased risk of metabolic syndrome, particularly in males, older individuals, overweight individuals and those with poor glycemic control. MPV levels are higher in patients with microvascular complications such as retinopathy and nephropathy.

Keywords: Glycated hemoglobin • Mean platelet volume • Metabolic syndrome • Diabetes mellitus • Obesity

Introduction

Mean Platelet Volume (MPV) is a measure of platelet size and elevated MPV levels have been linked to various diseases, including cardiovascular disease, myocardial infarction, lupus, rheumatoid arthritis, tuberculosis, ulcerative colitis, renal disease and pulmonary disease [1]. Studies have demonstrated increased MPV levels in patients with diabetes mellitus [2-4]. Diabetes Mellitus (DM), which is inadequately controlled, can lead to severe complications, underscoring the importance of maintaining glycemic control. The classification of diabetes as controlled or uncontrolled is based on glycated hemoglobin levels, with values above 7% indicating uncontrolled diabetes and values below 7% indicating controlled diabetes. Studies have shown that MPV levels are higher in patients with uncontrolled diabetes compared to those with controlled diabetes [5,6]. Several theories have been proposed to explain this observation [5]. One theory suggests that the increase in MPV in patients with high glucose levels is due to osmotic edema caused by the elevated levels of certain glucose metabolites. Another theory proposes that a high MPV reflects high turnover [7].

The glycated hemoglobin (HbA1c) level is a diagnostic criterion for diabetes mellitus. Specifically, HbA1c provides a measure of a patient's glycemic history over the past two-three months and is strongly correlated with the long-term complications of the disease. The relationship between the Mean Platelet Volume (MPV) and HbA1c levels is controversial in the medical literature. A study by Sahid M and Sarah D [8] of patients (both men and women aged ≥ 35 years) with Type 2 Diabetes Mellitus (T2DM) for short (1-5 years), medium (6-10 years), or long (>10 years) periods found no association between MPV

and HbA1c. The authors suggested that factors such as insulin resistance and deficiency, oxidative stress and inflammation may be responsible for this. Astuti DW, et al. [9] also supports this result. However, other studies have demonstrated a correlation between HbA1c levels and MPV in patients with T2DM [9,10]. Pujari MW and Desai PR [11] highlighted that an elevated MPV is closely associated with increased HbA1c levels.

Discussion

The research community is currently focusing on examining MPV as an inflammatory marker in the context of T2DM and obesity. MPV may be used as an indicator of the inflammatory burden associated with glycemic management and obesity in individuals with T2DM [12]. This hypothesis is supported by the robust correlation observed between MPV and waist circumference, while the established association between obesity and inflammation, as measured by BMI, is widely accepted [13].

According to various studies, it has been observed that MPV levels are higher in patients with diabetes mellitus. Furthermore, elevated Mean Platelet Volume (MPV) is strongly associated with an increased risk of cardiovascular disease and accelerated platelet production independent of diabetes mellitus [14]. Additionally, disorders such as obesity, dyslipidemia and hypertension, which are components of the metabolic syndrome, have also been associated with cardiovascular diseases [15]. Notably, MPV can serve as a useful diagnostic tool for detecting thrombotic complications in conjunction with Platelet Distribution Width (PDW) owing to their elevated levels in uncontrolled diabetes mellitus [6]. Ding Q, et al. [14] examined the potential link between MPV and metabolic syndrome in patients with T2DM and found that elevated MPV levels were associated with a higher risk of metabolic syndrome, particularly in males, older individuals, those who were overweight and those with poor glycemic control. However, further research is needed to establish a definitive relationship between the MPV and metabolic syndrome in patients with T2DM.

Elevated platelet activity is linked to the development of vascular complications [16]; thus, Mean Platelet Volume (MPV) may be involved in these effects [16,17]. MPV levels are higher in patients with microvascular complications than in those without these conditions [16]. Therefore, MPV may serve as an effective indicator to assess these issues [17]. Specifically, MPV has been reported to be higher in diabetic patients with retinopathy than in those without retinopathy [12,17]. There was no significant difference in MPV levels between

*Address for Correspondence: Athena D. Myrou, Department of Internal Medicine, University General Hospital AHEPA, Thessaloniki, Greece; E-mail: taniamyrou@gmail.com

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Received: 03 June, 2024, Manuscript No. jdcM-24-138020; **Editor Assigned:** 05 June, 2024, PreQC No. P-138020; **Reviewed:** 17 June, 2024, QC No. Q-138020; **Revised:** 22 June, 2024, Manuscript No. R-138020; **Published:** 29 June, 2024, DOI: 10.37421/2475-3211.2024.9.264

patients with no proliferative and proliferative retinopathy [18]. Diabetic nephropathy is another common microvascular complication characterized by microalbuminuria that can lead to proteinuria and kidney failure [19]. An association between MPV and albuminuria has been reported, with higher MPV levels being observed in patients with higher albuminuria [20]. Peripheral neuropathy is a consequence of diabetes and affects approximately half of the diabetic population. It is primarily located in the peripheral parts of the body and includes all nerve types. A relationship between MPV and peripheral neuropathy severity has been previously established [21].

The Mean Platelet Volume (MPV) is a parameter typically assessed in a routine Complete Blood Count (CBC) that reflects the average size of platelets in the blood. Platelets are small cell fragments responsible for blood clotting. As an important indicator, MPV can provide valuable insights into various health conditions including diabetes. In individuals with diabetes, there is growing interest in investigating the relationship between MPV and the disease. Although research suggests that MPV levels may be altered in patients with diabetes, findings are not entirely consistent across studies.

The Mean Platelet Volume (MPV) in individuals with Diabetes Mellitus (DM) is typically higher than that in individuals without diabetes of similar age and sex [22]. Platelets that are larger in size are younger in age and tend to have higher activity than smaller platelets, which are older cells and seem to play a role in vascular activity according to the Study of the Impact of Glycemic Status (HbA1c) on Platelet Activity measured by mean platelet volume and vascular complications in diabetic patients [23]. Studies have also suggested that higher MPVs are associated with complications of diabetes, particularly T2DM, where most studies have been conducted [1,5]. Increased MPV has been linked to poorly controlled blood sugar levels and increased platelet activity, which may contribute to a higher risk of thrombotic events such as heart attacks and strokes. Although these associations have been observed, causation has not yet been firmly established.

Platelets, which are known for their role in blood clotting, also play a significant role in inflammation. Platelets are essential for preventing excessive bleeding by forming clots and participate in immune responses and inflammatory processes. Platelets are considered inflammatory biomarkers for various reasons such as the release of inflammatory mediators, interactions with immune cells, adhesion and recruitment, formation of platelet-lymphocyte aggregates and thrombosis. Chronic low-grade inflammation is a characteristic feature of diabetes and platelets contribute to this inflammatory response. An elevated MPV level suggests an increase in platelet turnover and activation in response to the inflammatory environment associated with diabetes [24].

The clinical implications of the relationship between the Mean Platelet Volume (MPV) and diabetes remain unclear and it should be emphasized that the MPV alone does not serve as a conclusive diagnostic indicator for diabetes. It is frequently evaluated in conjunction with other clinical parameters. Some researchers have proposed that tracking changes in MPV over time may be clinically significant in predicting cardiovascular events in patients with diabetes [25].

The identification of the relationship between Mean Platelet Volume (MPV) and diabetes may have significant implications for the management of patients with diabetes. Healthcare providers might consider elevated MPV levels as

an additional factor when assessing the overall cardiovascular risk in diabetic individuals, given the vascular complications associated with diabetes such as retinopathy and Ischemic Heart Disease (IHD). Furthermore, in some studies, correlations have been found between MPV and albuminuria, as well as HbA1c levels [20,26-27]. It is worth noting that as MPV and PDW levels increased, HbA1c levels also increased [26]. Increased platelet size in diabetes is an indication of platelet activity and appears to be a prognostic biomarker for cardiovascular diseases [1]. Therefore, higher MPV levels may be a cause or consequence of vascular diseases [4]. As depicted in Table 1 there was a correlation between higher MPV and higher HbA1c levels, suggesting that higher MPV levels are more prevalent in patients with uncontrolled diabetes [26,28].

To use a formal tone, the rephrased text is as follows. It has been observed that patients with poor glycemic control and elevated MPV levels have a higher likelihood of developing complications, such as diabetic retinopathy, which can serve as a predictor of early vascular complications in diabetes by identifying higher MPV values [5,26,29]. Studies have demonstrated a correlation between MPV and glycemic control, suggesting that MPV can be used to monitor euglycemia in patients [23,28]. Citirik M, et al. [30] compared MPV levels in healthy individuals and diabetic patients with retinopathy and revealed that MPV can reflect platelet activation in diabetic patients, regardless of the stage of retinopathy. Additionally, a study by Ji S, et al. [31] found that although MPV levels are increased in diabetic retinopathy, MPV can be correlated with the stage of retinopathy and can be used to monitor the progression of the condition. Recent studies have also revealed a significant positive correlation between elevated MPV and albuminuria [4]. These findings are presented in Table 2.

Studies pertaining to Mean Platelet Volume (MPV) in the context of diabetes are ongoing and additional research is necessary to establish a conclusive and consistent relationship between the two. The effects of various diabetes management strategies on the MPV levels warrant further investigation. In summary, Mean Platelet is a significant parameter in the context of diabetes. Although elevated MPV levels have been observed in some individuals with diabetes, the precise mechanisms and clinical implications remain to be fully understood through ongoing research. Periodic monitoring of MPV, in conjunction with other relevant biomarkers, may contribute to a more comprehensive understanding of the cardiovascular risk profile in patients with diabetes. It is essential to recognize that individual patient cases should always be assessed by healthcare professionals, who can consider a range of factors when making clinical decisions.

Conclusion

This article discusses the relationship between the Mean Platelet Volume (MPV) and diabetes mellitus. MPV is a measure of platelet size and has been linked to various diseases. Studies have shown that MPV levels are higher in patients with uncontrolled diabetes than those with controlled diabetes. The relationship between MPV and HbA1c level is controversial in the medical literature, with some studies showing a correlation between the two. MPV may be used as an inflammatory marker in T2DM and obesity. MPV levels are associated with an increased risk of cardiovascular disease and accelerated

Table 1. Median values of variables [26].

	Average	Standard Deviation	Minimum	Maximum	Median
HbA1c	7.6	2.4	4.3	19.3	6.5
MPV	10.1	1.1	7.7	13.3	10
PDW	16	0.4	14.8	17.2	16

Table 2. MPV according to the compilation of type 2 diabetic patient [22].

Complication Mpv	Retinopathy	Without Retinopathy	Albuminuria	Without Albuminuria
Mpv	11.7 ± 0.8	9.6 ± 0.7	10.9 ± 0.4	8.8 ± 0.6
Statistical review	p=0.038	p=0.038	p=0.04	p=0.04

thrombopoiesis. MPV may serve as a useful diagnostic tool for detecting thrombotic complications in conjunction with Platelet Distribution Width (PDW) owing to their elevated levels in uncontrolled diabetes mellitus.

Acknowledgement

None.

Conflict of Interest

None.

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How to cite this article: Myrou, Athena D., Styliani A. Spanou, Christina P. Michael and Maria C. Christodoulou, et al. "The Relationship between Mean Platelet Volume and HbA1c in Patients with Diabetes Mellitus: A Controversial Topic." *J Diabetic Complications Med* 9 (2024): 264.