<u>Original Research Article</u>

The Study of Relationship Between Glycemic Control and Platelet Activity in Type 2 Diabetes Mellitus Patients of Tertiary Care Hospital at Rajpipla, Gujarat

Dipeeka D Patel[1], Nayan Chunilal Koitiya[2], Dipti Gajjar[3], Keyurkumar Gulabbhai[4]

[1]Tutor, Department of Pathology, GMERS Medical College, Rajpipla, Gujarat
[2]Associate professor, Department of Pathology, GMERS Medical College, Rajpipla, Gujarat
[3,4]Assistant Professor, Department of Pathology, GMERS Medical College, Rajpipla, Gujarat

Abstract:

Background: Type 2 diabetes mellitus (T2DM) is a prevalent metabolic disorder characterized by chronic hyperglycemia. Glycemic control in T2DM patients is crucial for minimizing complications, one of which is altered platelet activity, contributing to increased cardiovascular risk. This study aims to investigate the relationship between glycemic control and platelet activity in T2DM patients over a six-month period.

Materials and Methods: This prospective study was conducted at GMERS Medical College, Rajpipla, Gujarat, involving 110 T2DM patients. Glycemic control was assessed using HbA1c levels, measured at baseline and at six months. Platelet activity was evaluated through platelet aggregation tests and mean platelet volume (MPV). Patients were grouped based on their glycemic control: well-controlled (HbA1c < 7%) and poorly controlled (HbA1c $\geq$ 7%).

Results: At baseline, the mean HbA1c level was 8.2%. After six months, the well-controlled group showed a significant reduction in HbA1c to 6.8% ($p < 0.05$), while the poorly controlled group remained at 8.1%. Platelet aggregation decreased by 15% in the well-controlled group and increased by 5% in the poorly controlled group. Similarly, MPV decreased by 0.7 fL in the well-controlled group, compared to an increase of 0.2 fL in the poorly controlled group.

Conclusion: Effective glycemic control in T2DM patients significantly reduces platelet activity, potentially lowering the risk of cardiovascular events. Regular monitoring and management of blood glucose levels are essential for mitigating platelet hyperactivity and associated complications in T2DM.

Keywords: Type 2 diabetes mellitus, glycemic control, platelet activity, HbA1c, mean platelet volume, cardiovascular risk.

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and impaired insulin secretion, leading to persistent hyperglycemia. This condition affects millions of people worldwide and is associated with significant morbidity and mortality due to its complications, particularly cardiovascular diseases (CVD) [1]. Glycemic control, typically assessed by measuring glycated hemoglobin (HbA1c) levels, is a critical factor in the management of T2DM and in the prevention of its complications [2].

One of the mechanisms through which poor glycemic control exacerbates cardiovascular risk is through the alteration of platelet activity. Platelets play a pivotal role in thrombosis and hemostasis, and their hyperactivity is a well-recognized feature in T2DM patients [3]. Increased platelet aggregation and mean platelet volume (MPV) are markers of enhanced platelet reactivity, which contribute to the elevated incidence of thrombotic events observed in diabetic patients [4,5]. Previous studies have indicated that improved glycemic control can mitigate platelet hyperactivity, thereby potentially reducing the risk of cardiovascular events [6]. However, the extent and mechanisms of this relationship remain areas of active research. This study aims to investigate the impact of glycemic control on platelet activity over a six-month period in T2DM patients at GMERS Rajpipla, providing insights into the importance of maintaining optimal blood glucose levels for cardiovascular health.

Materials and Methods

Study Design and Participants: This prospective observational study was conducted at GMERS Medical College, Rajpipla, Gujarat over a period of six months. The study included 110 patients diagnosed with type 2 diabetes mellitus (T2DM). Inclusion criteria were adults aged 30-70 years with a confirmed diagnosis of T2DM for at least one year. Exclusion criteria included patients with type 1 diabetes, gestational diabetes, those on anticoagulant therapy, and individuals with known hematologic disorders or chronic inflammatory diseases.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee of GMERS Rajpipla. Written informed consent was obtained from all participants prior to their inclusion in the study.

Data Collection: At baseline, demographic data, medical history, and medication use were recorded. Fasting blood samples were collected from all participants to measure glycated hemoglobin (HbA1c) levels and platelet activity markers. The same measurements were repeated at the end of the six-month follow-up period.

Glycemic Control Assessment: Glycemic control was assessed using HbA1c levels, measured by high-performance liquid chromatography (HPLC). Patients were categorized into two groups based on their HbA1c levels at six months:

- Well-controlled group (HbA1c < 7%)
- Poorly controlled group (HbA1c ≥ 7%)

Platelet Activity Assessment: Platelet activity was evaluated using two primary markers: platelet aggregation and mean platelet volume (MPV). Platelet aggregation was assessed using light transmission aggregometry (LTA) following stimulation with adenosine diphosphate (ADP). MPV was measured using an automated hematology analyzer, which calculates the average size of platelets in the blood sample.

Statistical Analysis: Data were analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD).

Comparisons between the two groups were performed using the paired t-test for normally distributed variables and the Wilcoxon signed-rank test for non-normally distributed variables. A p-value of < 0.05 was considered statistically significant.

Study Flow

Baseline (Month 0): Collection of demographic data, medical history, and blood samples for HbA1c and platelet activity measurements.

Follow-up (Month 6): Repeat collection of blood samples for HbA1c and platelet activity measurements.

Data Analysis: Comparison of baseline and follow-up data to assess the relationship between glycemic control and changes in platelet activity.

This structured approach enabled a comprehensive evaluation of the impact of glycemic control on platelet function in T2DM patients over a six-month period.

Results

Patient Demographics and Baseline Characteristics: A total of 110 patients with type 2 diabetes mellitus (T2DM) were included in the study. The mean age of the participants was 55.2 ± 10.1 years, with 58 males and 52 females. The baseline characteristics of the study population are summarized in Table 1.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Value
Number of patients	110
Age (years)	55.2 ± 10.1
Gender (M/F)	58/52
Duration of diabetes (years)	8.5 ± 5.2
Baseline HbA1c (%)	8.2 ± 1.3

Glycemic Control: After six months, 60 patients achieved good glycemic control (HbA1c < 7%), while 50 patients had poor glycemic control (HbA1c ≥ 7%). The mean HbA1c levels at baseline and six months for both groups are shown in Table 2.

Table 2: Glycemic Control in Study Participants

Group	Baseline HbA1c (%)	HbA1c at 6 months (%)
Well-controlled (n=60)	8.0 ± 1.2	6.8 ± 0.6*
Poorly controlled (n=50)	8.4 ± 1.4	8.1 ± 1.3

*Significant reduction in HbA1c (p < 0.05)

Platelet Activity: Platelet aggregation and mean platelet volume (MPV) were measured at baseline and six months. The changes in these parameters are summarized in Table 3 and Table 4.

Patel *et al.*   **International Journal of Pharmaceutical and Clinical Research**

Table 3: Platelet Aggregation in Study Participants

Group	Baseline Aggregation (%)	Aggregation at 6 months (%)
Well-controlled (n=60)	70.5 ± 12.3	55.0 ± 10.5*
Poorly controlled (n=50)	72.0 ± 11.8	75.6 ± 12.0

*Significant reduction in platelet aggregation (p < 0.05)

Table 4: Mean Platelet Volume (MPV) in Study Participants

Group	Baseline MPV (fL)	MPV at 6 months (fL)
Well-controlled (n=60)	10.1 ± 1.2	9.4 ± 1.0*
Poorly controlled (n=50)	10.3 ± 1.3	10.5 ± 1.2

*Significant reduction in MPV (p < 0.05)

Summary of Findings

Glycemic Control: The well-controlled group showed a significant reduction in HbA1c levels from 8.0% to 6.8% (p < 0.05), whereas the poorly controlled group showed no significant change.

Platelet Aggregation: Platelet aggregation decreased by 15.5% in the well-controlled group and increased by 3.6% in the poorly controlled group (p < 0.05).

Mean Platelet Volume (MPV): MPV decreased by 0.7 fL in the well-controlled group and increased by 0.2 fL in the poorly controlled group (p < 0.05).

The results indicate that effective glycemic control significantly reduces platelet activity, as evidenced by decreases in both platelet aggregation and MPV in the well-controlled group.

Discussion

This study aimed to evaluate the impact of glycemic control on platelet activity in patients with type 2 diabetes mellitus (T2DM) over a six-month period. The findings demonstrate that improved glycemic control, as indicated by reduced HbA1c levels, is associated with a significant reduction in platelet activity, measured by both platelet aggregation and mean platelet volume (MPV).

The relationship between hyperglycemia and increased platelet reactivity is well-documented. Chronic hyperglycemia promotes oxidative stress and the formation of advanced glycation end-products (AGEs), which enhance platelet activation and aggregation [1]. These alterations in platelet function contribute to the prothrombotic state observed in T2DM, increasing the risk of cardiovascular events [2].

In this study, patients who achieved good glycemic control (HbA1c < 7%) exhibited a significant decrease in both platelet aggregation and MPV after six months. These findings are consistent with previous research suggesting that intensive glycemic control can mitigate platelet hyperactivity. For instance, Ceriello et al. reported that improved glycemic control reduced oxidative stress and platelet aggregation in diabetic patients [3]. Similarly, a study by Esteghamati et al. found that tighter glycemic control was associated with lower MPV, indicating reduced platelet activation [4]. Conversely, patients with poor glycemic control (HbA1c ≥ 7%) did not show significant changes in platelet activity. This underscores the importance of maintaining optimal blood glucose levels to prevent the deleterious effects of hyperglycemia on platelet function. The persistence of elevated HbA1c levels in these patients likely perpetuated the oxidative stress and inflammatory pathways that enhance platelet reactivity [5].

The clinical implications of these findings are substantial. Platelet hyperactivity is a major contributor to the increased incidence of thrombotic events in T2DM patients. By effectively managing blood glucose levels, it may be possible to reduce the risk of cardiovascular complications in this population. This study adds to the growing body of evidence supporting the need for stringent glycemic control in the management of T2DM [6].

However, the study has some limitations. The observational design precludes establishing a causal relationship between glycemic control and changes in platelet activity.

Additionally, the study did not account for other factors that may influence platelet function, such as concomitant medications, dietary habits, and lifestyle changes. Future studies with a larger sample size and randomized controlled design are warranted to confirm these findings and explore the underlying mechanisms further.

Conclusion

In conclusion, this study demonstrates that effective glycemic control in T2DM patients significantly reduces platelet activity, potentially lowering the risk of cardiovascular events.

These findings highlight the importance of regular monitoring and management of blood glucose levels to mitigate platelet hyperactivity and associated complications in T2DM.

References

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