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Association between Coagulation Profiles and Platelet Count in Type 2 Diabetes Mellitus Patients: Insights from a Study in Nepal

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ABSTRACT

Type 2 Diabetes Mellitus (T2DM) presents a significant global health challenge, affecting metabolic processes and increasing cardiovascular risk. Elevated blood sugar levels in diabetes contribute to heightened clot formation and disrupt coagulation mechanisms, fostering atherosclerosis and altering platelet activity. This study aims to analyze the coagulation markers Prothrombin Time (PT), Partial Thromboplastin Time (PTT), and platelet counts in T2DM patients, investigating the influence of elevated blood sugar levels on coagulation changes. Conducted at the Nepal Cardio Diabetes and Thyroid Centre, this cross-sectional observational study selected T2DM-diagnosed patients as cases and healthy individuals as controls. Blood samples were analyzed using standard techniques, and statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 21. Significant differences were observed in PT, International Normalized Ratio (INR), PTT, and platelet counts between the cases and controls, indicating altered coagulation pathways and reduced platelet counts in T2DM patients. These findings suggest a hypercoagulable state in diabetic patients, contributing to atherogenesis.

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Abbreviations

DIC, Disseminated Intravascular Coagulation; INR, International Normalized Ratio; M ± SD, Mean ± Standard Deviation; NCDTC, Nepal Cardio Diabetes and Thyroid Centre; PT, Prothrombin Time; PTT, Partial Thromboplastin Time; PPP, Platelet Poor Plasma; SPSS, Statistical Package for the Social Sciences; T2DM, Type 2 Diabetes Mellitus

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and elevated blood glucose levels [1]. The global burden of T2DM is rising [2], with projections suggesting that the number of affected individuals will increase to 700.2 million by 2045. The prevalence of diabetes in Southeast Asia was 8.8% in 2019 and is expected to reach 9.7% by 2030 [2]. T2DM contributes to significant morbidity and mortality, leading to complications such as neuropathy, stroke, and cardiovascular diseases. In Nepal, over 10,000 deaths in 2017 were attributed to T2DM, with the prevalence increasing slightly from 8.4% in 2014 to 8.5% in 2020. In response, the Nepalese government has adopted a multi-sectoral action plan to address non-communicable diseases, including T2DM [3].

Individuals with diabetes often exhibit a procoagulant state due to abnormalities in various plasma proteins involved in blood coagulation [4]. This procoagulant state, characterized by hypercoagulability and hypofibrinolysis, contributes to atherosclerosis and endothelial dysfunction, leading to increased platelet and clotting factor activation. The underlying mechanisms linking hyperglycemia to these coagulation changes are supported by in vitro studies that demonstrate the direct effects of glucose on the coagulation system [4, 5]. Diagnostic tests for coagulation issues typically include prothrombin time (PT), activated partial thromboplastin time (PTT), bleeding time, and clotting factor concentrations [6, 7]. Understanding these coagulation changes is crucial for developing targeted strategies to reduce cardiovascular events in individuals with diabetes. Therefore, this study aims to evaluate alterations in coagulation parameters specifically PT, PTT, and platelet counts in patients with T2DM. The objective of this study is to analyze coagulation markers, specifically PT, PTT, and platelet counts in T2DM patients. By exploring the influence of elevated blood glucose levels on coagulation changes, the study seeks to provide insights into the thrombotic risks associated with T2DM and emphasize the need for targeted therapeutic strategies.

Materials and Methods

Study Design

This is a cross-sectional, observational study conducted at the Nepal Cardio Diabetes and Thyroid Center (NCDTC) from June 2022 to June 2023. A total of 1,250 patients diagnosed with T2DM and an equal number of healthy controls were selected. Cases were chosen from T2DM patients attending the clinic, while healthy controls were selected from individuals visiting for a general health checkup. The study excluded patients with disorders that could affect blood clotting, such as disseminated intravascular coagulation (DIC), liver disease, and those using warfarin (Coumadin).

Sample Size Calculation

The sample size was calculated based on previous studies demonstrating differences in coagulation parameters between T2DM patients and healthy controls [4]. The sample size was determined using the following formula:

$$n = (Z_{\alpha/2} + Z_{\beta})^2 \times (\sigma_1^2 + \sigma_2^{2)} / (M_1 - M_2)^2$$

- M1 and M2 are the means of the two groups,
- σ12 and σ22 are the variances of the two groups,
- Z α/2 is the Z-score corresponding to the desired confidence level (α),
- Zβ is the Z-score corresponding to the desired power of the test (β).

Data Collection and Analysis

Five milliliters of blood samples were drawn from each participant using standard venipuncture techniques. The samples were then centrifuged at 3,000 rpm for 15 minutes to obtain platelet-poor plasma (PPP) and transparent plasma.

The separated plasma was analyzed for PT and PTT using standard laboratory methods. Platelet counts were measured using an automated hematology analyzer [7]. Statistical analyses were performed using SPSS version 21. Data were expressed as mean ± standard deviation (M ± SD). Differences between the groups were assessed using the independent t-test, and correlations were analyzed using Pearson's correlation coefficient. A p-value < 0.05 was considered statistically significant. All participants provided informed consent prior to sample collection.

Results

A total of 1,250 patients diagnosed with Type 2 Diabetes Mellitus and an equal number of healthy individuals were included in the study. Among the participants, 688 were male and 562 were female. The mean age of the control group was 41.22 ± 8.30 years, while the mean age of the T2DM group was 50 ± 9.88 years (Figure 1).

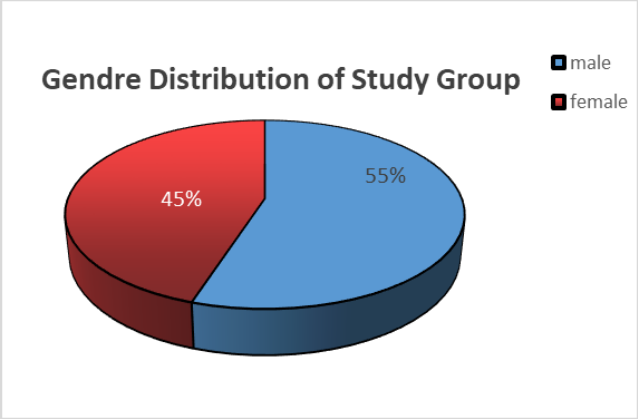

Figure 1. Gender Distribution in the Study Population.

Demographic Characteristics

Table 1 presents the demographic characteristics of the study participants, including age, BMI, and gender. These characteristics were compared between the T2DM patients and healthy controls to identify potential biases that could influence the results.

Table 1. Demographic Characteristics of Study Participants.

Parameter	T2DM (M ± SD)	Control (M ± SD)	P-value
Age (years)	50 ± 9.88	41.22 ± 8.30	< 0.001
BMI (kg/m²)	28.5 ± 4.2	24.3 ± 3.8	< 0.001
Gender (M/F)	688/562	688/562	1

BMI, Body mass index; T2DM, Type 2 diabetes mellitus; M, Male; F, Female; M ± SD, Mean ± Standard deviation

The results showed significant differences in PT, INR, PTT, and platelet counts between the T2DM group and the control group (Table 1). Specifically, the mean PT was 15 seconds in patients with T2DM compared to 12.4 seconds in controls ($p < 0.005$). The mean INR was 1.3 in patients with T2DM compared to 1.1 in controls ($p = 0.000$). The mean PTT was 44 seconds in patients with T2DM compared to 28 seconds in controls ($p < 0.005$). Platelet counts were significantly lower in the T2DM group (168.72 × 10^3/L) compared to controls (230.72 × 10^3/L), with a p-value < 0.005.

Table 2. Comparison of PT, INR, PTT, and Platelet Counts between Case and Control Groups.

Parameter	Patients (mean)	Controls (mean)	p-value
PT	15 seconds	12.4 seconds	< 0.005
INR	1.3	1.1	0
PTT	44 seconds	28 seconds	< 0.005
Platelets	168.72 × 10^3/L	230.72 × 10^3/L	< 0.005

PT, Prothrombin Time; INR, International Normalized Ratio; PTT, Partial Thromboplastin Time

Data were analyzed using independent t-tests for continuous variables to compare the means between the T2DM group and the control group.

Discussion

The findings of this study underscore the heightened risk of atherothrombotic complications in patients with T2DM. The observed alterations in coagulation markers, along with reduced platelet counts, highlight the hypercoagulable state associated with diabetes. This hypercoagulability could contribute to increased atherogenesis and a higher incidence of cardiovascular events [7]. Our study reveals a significant increase in activated PTT, PT, and INR values among diabetic patients, consistent with the findings of Mohammed *et al.* [7]. This contrasts with previous studies that reported lower coagulation test results in diabetic patients [8, 9]. Furthermore, we observed significantly lower platelet counts in our case-control comparison, which aligns with the results reported by Hekimsoy *et al.* [10], but diverges from other studies [11], [12]. In contrast, Chen *et al.* [13] found no significant difference in platelet levels between diabetic and non-diabetic populations.

Conclusion

Type 2 Diabetes Mellitus is associated with significant alterations in coagulation profiles and platelet counts, indicating an elevated risk of thrombotic complications. The findings of this study highlight the importance of monitoring coagulation markers in diabetic patients to develop targeted interventions aimed at mitigating cardiovascular risks. However, the study acknowledges limitations in assessing comprehensive coagulation factors. Future research should incorporate advanced tests, such as immunoassays, to provide a more detailed understanding of coagulation changes in T2DM.

Declaration

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Conflicts of interest/Competing interests

The authors declare no conflict of interest.

Authors' contributions

UB Conceived the study, performed data analysis, and drafted the manuscript. AB Provided clinical insights and reviewed the manuscript. SS Contributed to study design and data interpretation.

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