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ROUTINE HEMATOLOGICAL PROFILE OF TYPE 2 DIABETES MELLITUS PATIENTS AT BANTEN PROVINCIAL GENERAL HOSPITAL

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ABSTRACT

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disease characterized by hyperglycemia resulting from impaired insulin secretion, insulin resistance, or a combination of both. Prolonged hyperglycemia can induce changes in hematological parameters through mechanisms involving chronic inflammation, oxidative stress, and vascular endothelial damage. This study aimed to assess the routine hematological profile of T2DM patients at the Banten Provincial General Hospital (RSUD). An observational descriptive study with a cross-sectional design was employed. The study sample consisted of 30 T2DM patients selected using purposive sampling. Data were obtained through routine hematological analysis using a hematology analyzer, while respondent characteristics were gathered via questionnaires and medical records. The results showed that the majority of respondents were aged 56–65 years (40.0%), female (56.7%), and had been diagnosed with T2DM for 1–5 years (66.7%). Routine hematological examinations revealed that most respondents had hemoglobin levels, hematocrit, leukocyte counts, and platelet counts within the normal range. However, elevated or decreased values in these hematological parameters were observed in a small proportion of respondents. It is concluded that most T2DM patients at the Banten Provincial General Hospital exhibit routine hematological profiles within normal limits. Nevertheless, alterations in certain hematological parameters were still observed, suggesting that routine hematological examination could serve as a useful supportive test for monitoring the condition of T2DM patients.

Keywords: Type 2 Diabetes Mellitus; Hemoglobin; Leukocytes; Hematocrit; Platelets

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by hyperglycemia resulting from insulin resistance, impaired insulin secretion, or a combination of both. Prolonged hyperglycemia can disrupt carbohydrate, lipid, and protein metabolism and contribute to various complications, including damage to the kidneys, nerves, eyes, heart, and blood vessels. Diabetes mellitus is a non-communicable disease with a steadily rising global prevalence. The prevalence of DM is estimated to affect approximately 8.3% of the global population; meanwhile, in Banten Province, the physician-diagnosed prevalence of DM in 2023 reached 1.9% across various age groups (Ahmad, 2019; Ariyadi & Septiawan, 2024; Dewa et al., 2022)

In addition to causing metabolic disturbances, chronic hyperglycemia in T2DM patients can affect various blood components. Hemoglobin is one parameter subject to change. DM patients, particularly those with impaired renal function, are at risk of reduced hemoglobin levels due to decreased production of erythropoietin, a hormone essential for erythrocyte formation. Previous studies indicate that the majority of T2DM patients with renal impairment exhibit hemoglobin levels below the normal range, making anemia a hematological condition that requires attention in DM patients (Dewa et al., 2022).

Hematocrit is another hematological parameter that can undergo changes. Prolonged hyperglycemia can induce osmotic diuresis and alter plasma volume, thereby affecting hematocrit values. Furthermore,

chronic inflammation and metabolic alterations associated with T2DM can influence erythrocyte characteristics and lifespan. Research by Noubou et al. demonstrates a link between hematocrit levels and glycemic control in T2DM patients, showing a tendency for higher hematocrit values in patients with poor glycemic control (Kemenkes RI, 2023)

Chronic hyperglycemia is also associated with inflammatory processes and metabolic stress that can affect leukocyte counts. Elevated leukocyte counts in patients with type 2 diabetes mellitus (T2DM) may reflect a chronic inflammatory response resulting from insulin resistance and hyperglycemia. Moradi et al. reported that patients with T2DM—particularly those with complications—tend to exhibit higher leukocyte counts, even if the values remain within the reference range. This suggests that leukocyte assessment can provide additional information regarding the inflammatory status of T2DM patients (Fitri Shiva, 2021).

Platelets also play a crucial role in the pathogenesis of diabetic complications. Chronic hyperglycemia can induce oxidative stress and endothelial dysfunction, thereby increasing platelet activation and reactivity. These changes can heighten the propensity for platelet aggregation and contribute to vascular complications, affecting both macrovascular and microvascular systems. Several studies have demonstrated alterations in platelet count and function in T2DM patients, especially in those with complications such as diabetic ulcers (Elsayed et al., 2023).

Although various studies have reported changes in hematological parameters among T2DM patients, the routine hematological profile of these patients warrants further investigation across different populations and healthcare settings. Routine hematological tests—including hemoglobin levels, hematocrit, leukocyte counts, and platelet counts—are relatively simple and widely available laboratory procedures that offer the potential to provide additional clinical insights into the condition of patients with T2DM.

Based on the foregoing, this study aims to determine the routine hematological profile—including hemoglobin levels, hematocrit values, leukocyte counts, and platelet counts—of patients with type 2 diabetes mellitus at the Banten Provincial General Hospital (RSUD). The findings are expected to provide insight into changes in hematological parameters among type 2 diabetes patients and serve as supporting information for monitoring patient conditions and the risk of diabetes-related complications.

MATERIALS AND METHODS

This study employed a descriptive observational design with a cross-sectional approach to describe platelet counts among patients with type 2 diabetes mellitus (T2DM) who underwent laboratory examinations at the Regional General Hospital of Banten Province (RSUD Provinsi Banten), Indonesia. The study was conducted in the hospital laboratory in May 2026. The study population consisted of all patients with T2DM who visited the laboratory of RSUD Provinsi Banten during April–May 2026. Participants were selected using purposive sampling based on predetermined inclusion and exclusion criteria. The inclusion criteria were: (1) patients diagnosed with T2DM based on medical records; (2) patients aged >26 years; and (3) outpatients. The exclusion criteria were: (1) patients with a history of bleeding or blood transfusion within the previous three months; and (2) patients taking medications that may affect platelet count or function, such as aspirin, clopidogrel, or heparin.

The minimum sample size was calculated using the Lemeshow formula with a standard value (Z) of 1.96, an estimated proportion (P) of 0.5, and a margin of error (d) of 18%. The calculation resulted in a minimum sample size of 30 participants. Therefore, the sample size was rounded up to 30 participants to account for the possibility of incomplete data or non-response.

The equipment used for blood collection and hematological examination included a 3-mL syringe, alcohol swabs, tissue, tourniquet, EDTA blood collection tubes, wound plasters, and a hematology analyzer. The specimen used in this study was venous blood collected into EDTA tubes.

Data were collected through primary data collection, including direct interviews with participants using a structured questionnaire. The questionnaire was used to obtain demographic and clinical information, including sex, age, and duration of T2DM. Before data collection, the researcher obtained permission from the hospital and prepared the required equipment, materials, questionnaire, and informed consent form. The researcher explained the study procedures to eligible participants and obtained informed consent before sample collection.Venous blood samples were collected from eligible participants using standard phlebotomy procedures. Blood collection was performed with the assistance and supervision of personnel holding a valid Registration Certificate (STR). The collected blood specimens were subsequently examined using a hematology analyzer to determine the platelet count. The collected data were recorded and analyzed descriptively. Platelet counts were presented as frequencies, percentages, means, standard deviations, or medians, as appropriate. Participant characteristics, including age, sex, and duration of T2DM, were also

presented descriptively. The results were presented in tables to describe the platelet profile of patients with T2DM.

This study was conducted in accordance with ethical principles for research involving human participants. Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Banten approval No.PP.06.02/F.XXII/2022/2026. Written informed consent was obtained from all participants prior to their participation in the study and the collection of blood samples. The confidentiality and privacy of participants' personal information were maintained throughout the study.

RESULTS AND DISCUSSION

A total of 30 patients with type 2 diabetes mellitus (T2DM) were included in this study. The participants were predominantly aged 56–65 years (40.0%), followed by those aged 46–55 years (23.3%). Female participants accounted for 56.7% of the sample, while males accounted for 43.3%. Most participants had been diagnosed with T2DM for 1–5 years (66.7%). All participants reported routine blood glucose testing and the use of antidiabetic medication. Based on random blood glucose levels, 19 participants (63.3%) had levels ≥200 mg/dL, while 11 participants (36.7%) had levels <200 mg/dL.

Table 1. Characteristics of Patients with Type 2 Diabetes Mellitus

Characteristics	n	%
Age (years)		
26–35	2	6.7
36–45	4	13.3
46–55	7	23.3
56–65	12	40.0
>65	5	16.7
Sex		
Male	13	43.3
Female	17	56.7
Duration of T2DM (years)		
1–5	20	66.7
6–10	4	13.3
11–15	4	13.3
16–20	2	6.7
Random blood glucose (mg/dL)		
<200	11	36.7
≥200	19	63.3

The distribution of routine hematological parameters showed that most participants had hemoglobin, hematocrit, and platelet counts within the reference range. However, leukocytosis was observed in 14 participants (46.7%), representing the most frequent hematological abnormality in this study.

Table 2. Distribution of Routine Hematological Parameters According to Sex

Parameter	Category	Male n (%)	Female n (%)	Total n (%)
Hemoglobin	Low	3 (25.0)	1 (5.6)	4 (13.3)
	Normal	9 (75.0)	17 (94.4)	26 (86.7)
	High	0 (0.0)	0 (0.0)	0 (0.0)
Hematocrit	Low	2 (16.7)	3 (16.7)	5 (16.7)
	Normal	9 (75.0)	15 (83.3)	24 (80.0)
	High	1 (8.3)	0 (0.0)	1 (3.3)
Leukocyte count	Low	0 (0.0)	0 (0.0)	0 (0.0)
	Normal	8 (66.7)	8 (44.4)	16 (53.3)
	High	4 (33.3)	10 (55.6)	14 (46.7)
Platelet count	Low	1 (8.3)	1 (5.6)	2 (6.7)
	Normal	10 (83.3)	15 (83.3)	25 (83.3)
	High	1 (8.3)	2 (11.1)	3 (10.0)

Note: Low, normal, and high categories were determined according to the laboratory reference ranges.

Most participants had hemoglobin concentrations within the reference range (86.7%). Normal hemoglobin was observed in 75.0% of male participants and 94.4% of female participants. Reduced hemoglobin concentrations were found in 13.3% of participants, consisting of three males and one female. No participants had hemoglobin concentrations above the reference range. The majority of participants had normal hematocrit values (80.0%). Normal hematocrit was observed in 75.0% of males and 83.3% of females. Low hematocrit was found in 16.7% of participants, while only one male participant (3.3%) had an elevated hematocrit. A normal leukocyte count was found in 53.3% of participants, whereas 46.7% had leukocytosis. Leukocytosis was more frequently observed among females (55.6%) than males (33.3%). No participants had leukopenia. Most participants had normal platelet counts (83.3%). Thrombocytopenia was observed in 6.7% of participants, while thrombocytosis was found in 10.0%. The proportion of thrombocytosis was slightly higher among females (11.1%) than males (8.3%).

The present study demonstrated that the majority of patients with T2DM were aged 56–65 years. This finding is consistent with the increased risk of T2DM associated with aging. Advancing age is accompanied by changes in body composition, decreased insulin sensitivity, and progressive impairment of pancreatic β-cell function, which may contribute to disturbances in glucose metabolism. The predominance of older adults in this study may also explain the presence of hematological abnormalities in some participants, considering that aging and chronic metabolic disorders may coexist with renal dysfunction, inflammation, and other comorbidities.

Female participants were slightly more predominant than males (56.7%). This distribution may be related to differences in body composition, hormonal changes, and metabolic alterations associated with aging, particularly during the postmenopausal period. However, because this study was descriptive and involved a relatively small sample, the observed sex distribution should not be interpreted as evidence that female sex is a direct determinant of T2DM or hematological abnormalities.

Most participants had experienced T2DM for 1–5 years. Nevertheless, 30.0% had lived with diabetes for more than five years. The duration of diabetes is clinically important because prolonged exposure to hyperglycemia may increase the risk of microvascular and macrovascular complications. In this study, 63.3% of participants had random blood glucose levels ≥200 mg/dL despite all participants reporting antidiabetic medication use. This finding suggests that the use of antidiabetic medication does not necessarily indicate optimal glycemic control. However, random blood glucose measurements alone cannot be used to comprehensively assess long-term glycemic control; parameters such as HbA1c would provide a more representative assessment.

Most participants (86.7%) had normal hemoglobin concentrations, while 13.3% had low hemoglobin levels. The predominance of normal hemoglobin suggests that most participants in this study did not have a marked reduction in erythrocyte mass. However, anemia in patients with T2DM may occur particularly in the presence of chronic kidney disease, because impaired renal function can reduce erythropoietin production and subsequently decrease erythropoiesis.

Chronic inflammation associated with T2DM may also contribute to anemia through impaired iron utilization and suppression of erythropoiesis. Other factors, including iron deficiency, nutritional status, age, and concomitant diseases, may additionally influence hemoglobin concentrations. Therefore, the low hemoglobin observed in several participants cannot be attributed solely to diabetes because renal function, iron status, and other potential causes of anemia were not assessed in this study (Hutama et al., 2021).

Normal hematocrit values were observed in 80.0% of participants, while 16.7% had low hematocrit values and 3.3% had an elevated value. The predominance of normal hematocrit is consistent with the high proportion of participants with normal hemoglobin. Hemoglobin and hematocrit are closely related because both reflect the erythrocyte component of whole blood (Ariyadi & Septiawan, 2024).

Low hematocrit may occur in association with anemia, chronic inflammation, nutritional deficiencies, or impaired erythropoietin production in patients with renal dysfunction. Conversely, the elevated hematocrit observed in one participant may be related to reduced plasma volume. In patients with marked hyperglycemia, osmotic diuresis can lead to fluid loss and hemoconcentration, potentially resulting in an apparent increase in hematocrit. Nevertheless, this interpretation should be considered cautiously because hydration status and renal function were not specifically evaluated in the present study.

Leukocytosis was identified in 46.7% of participants, making it the most prominent hematological abnormality observed in this study. This finding may reflect the low-grade chronic inflammatory state frequently associated with T2DM. Persistent hyperglycemia and insulin resistance can promote oxidative stress and the release of proinflammatory mediators, contributing to systemic inflammatory activity (Giyartika & Keman, 2020).

The higher proportion of leukocytosis among female participants compared with male participants should be interpreted cautiously because the sample size was small and the study was not designed to evaluate sex-based differences. In addition, leukocyte elevation may be influenced by factors other than diabetes, including acute infection, chronic inflammatory conditions, smoking, medication use, and other comorbidities. Therefore, leukocytosis in this study should be interpreted as a hematological finding that may accompany T2DM rather than as a specific marker of diabetic complications.

The finding is broadly consistent with previous research reporting increased leukocyte counts among patients with T2DM. Increased leukocyte activity has been associated with chronic inflammation and may contribute to endothelial dysfunction and vascular complications. Nevertheless, additional inflammatory markers and clinical information would be necessary to establish the underlying cause of leukocytosis in individual patients (Giyartika & Keman, 2020).

The majority of participants (83.3%) had platelet counts within the normal range. Thrombocytopenia was observed in 6.7% of participants, while thrombocytosis was observed in 10.0%. The predominance of normal platelet counts indicates that major abnormalities in platelet number were not common in this study population.

Thrombocytosis in patients with T2DM may be associated with chronic inflammatory processes. Inflammatory mediators, particularly interleukin-6, can stimulate thrombopoiesis and potentially contribute to increased platelet production. In addition, chronic hyperglycemia and oxidative stress may induce endothelial dysfunction and platelet hyperreactivity, which are important mechanisms underlying the increased thrombotic risk associated with diabetes. However, platelet count alone does not directly represent platelet function or platelet activation (Wundiawan et al., 2023).

The small proportion of participants with thrombocytopenia may have been influenced by various factors, including medication, nutritional status, infection, liver or renal dysfunction, or increased platelet destruction. Because these variables were not specifically examined, the cause of thrombocytopenia cannot be determined from the present study (Widiarumiarso, 2018).

Overall, the findings indicate that although most patients with T2DM in this study had hematological parameters within normal limits, abnormalities were still observed, particularly leukocytosis (46.7%), followed by low hematocrit (16.7%), low hemoglobin (13.3%), thrombocytosis (10.0%), and thrombocytopenia (6.7%). These findings highlight the potential value of routine hematological assessment as complementary information in the clinical evaluation of patients with T2DM. However, the findings should be interpreted within the limitations of the descriptive cross-sectional design, relatively small sample size, and absence of additional variables such as HbA1c, renal function, inflammatory markers, nutritional status, and diabetes complications.

CONCLUSION

The study showed that most patients with T2DM had normal hemoglobin, hematocrit, and platelet counts, while leukocytosis was the most frequently observed hematological abnormality. These findings suggest that routine hematological examination may provide additional clinical information in patients with T2DM, although further studies with larger samples and additional clinical and biochemical parameters are needed to determine the factors associated with these hematological changes.

CONFLICT OF INTEREST

The authors declare that there are no financial conflicts of interest related to the conduct, publication, or preparation of this manuscript. No financial support, funding, or commercial interests influenced the design, data collection, analysis, interpretation, or reporting of the study.

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