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Original Research Article

Significance of Hematological Parameters in Uncomplicated Diabetes Mellitus

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Abstract

Background: Globally, diabetes mellitus is the leading cause of chronic metabolic disorders. The hematological values on a complete blood count show the physiochemical alterations in the blood caused by continuous hyperglycemia. This study aims to assess the usefulness of hematological markers in the management of uncomplicated diabetes mellitus.

Method: During the 12-month period from July 2022 to June 2023, a case control study was conducted at the Department of Pathology, Darbhanga Medical College & Hospital, Laheriasarai, Bihar, a tertiary care facility. A combination of clinical findings, case records, hematological findings, and a questionnaire were used to assess the 50 patients in the study group who had diabetes and the 50 patients in the control group who did not. Using a Beckman Coulter five part cell counter, the hemogram was analyzed. Peripheral smears stained with Leishman were examined. The significance test was used to analyze the gathered data in order to determine the significance of alterations in hematological markers in patients with diabetes.

Results: The diabetic group exhibited anemia as well as elevated leucocyte and platelet counts.

Conclusion: An effective method for improving the care of diabetes patients is the monitoring of changes in hematological markers.

Keywords: Diabetes mellitus, anaemia, erythropoiesis

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Introduction

A major global pandemic of diabetes mellitus is linked to considerable morbidity and mortality. Urbanization and unfavorable lifestyle changes, such as unhealthy eating habits and sedentary lifestyles, are to blame for the rising incidence, which is affecting younger people more and younger. [1] The International Diabetes Federation estimated that 415 million people worldwide had diabetes in 2015, and by 2040, they expected that figure to have increased to 642 million. [2] India is recognized as the global hub for diabetes, with an estimated 80–87 million Indians expected to have the disease by 2030. [3,4] Regularly high blood sugar levels are linked to alterations in the structure and function of the hemoglobin molecule, as well as cytoplasmic viscosity, osmotic disruptions, and oxidative stress that impacts cellular metabolism and manifests itself in a range of haematological indicators.

Changes in the different hemogram parameters are used to illustrate this. Red blood cell physiochemical alterations caused by the glycation of the hemoglobin molecule are represented in measures such as MCV, MCH, MCHC, and RDW. [5] A common hematological finding in patients with diabetes is anemia. Although the role of renal impairment in the etiopathogenesis of anemia is well documented, investigations have shown that anemia and diabetes may be associated in people even before renal insufficiency develops. [6,7] Individuals diagnosed with diabetes mellitus exhibit notable abnormalities in a number of haematological markers. In actuality, it has been demonstrated that DM is directly linked to a number of haematological abnormalities that impact platelets, white blood cells (WBCs), red blood cells (RBCs), and coagulation factors. In patients with type 2 diabetes, an elevated RDW value has been shown to be strongly related with diabetic nephropathy, even in the absence of traditional risk variables like glycemic control and the length of the patient's diabetes. RDW is now thought of as an inflammatory measure. [8] An elementary inflammatory marker that can be utilized to gauge oxidative stress at the cellular level is elevated WBC count.

Certain indicators such as the platelet count and the platelet to lymphocyte ratio can be used to indicate endothelial dysfunction. [9]

A complete blood count is a fundamental test that is usually recommended. It can be used to predict glycemic control and, consequently, the many degenerative problems of diabetes mellitus. [10]

Material and Method

During the 12-month period from July 2022 to June 2023, a case control study was conducted at the Department of Pathology, Darbhanga Medical College & Hospital, Laheriasarai, Bihar, a tertiary care facility. For every category listed below, there were fifty subjects. A thorough history, clinical findings, case studies from the past, and hematological results were used to examine the subjects.

Patients were selected from among outpatients who came to the lab. To determine the importance of the variations in hematological parameters between the two groups, the data was analyzed using the test of significance. Group 1 consisted of all type 2 diabetic patients who visited the outpatient department without complications (n = 50), while Group 2 consisted of healthy persons who visited the outpatient department for minor ailments or routine health checkups (n = 50) and hospital staff. Patients on insulin, aspirin, or antiplatelet medications, as well as those with any other acute unrelated illness, were excluded from Group 1 diabetes patients with micro- or macrovascular problems. Group 2 patients with a history of any chronic illness or acute infectious disease were also excluded from the study.

Samples were obtained, and a Beckman Coulter five part cell counter was used to analyze the hemogram after 2 ml of venous blood was collected in EDTA bulbs under aseptic circumstances. Leishman stain-stained peripheral smears were examined.

Results

Each group in our study consisted of fifty participants. The patients in group 1 ranged in age from 38 to 59 years old, with a mean age of 48.7 years. There were eighteen females and thirty-two males. The subjects in the control group ranged in age from 35 to 60 years old, with a mean age of 46.9. Table 1 shows that there were 21 females and 29 males. Regarding the age and sex distribution of the two groups, there was no discernible difference. Patients in group 1 had an average diabetes history of 5.3 years, ranging from 2 to 10 years.

Table 1 : Age and Gender distribution of studypopulation

	Diabetics	Non Diabetics	p value
Males	32(64%)	29(58%)	0.385
Females	18(36%)	21(42%)	0.385
Mean Age	48.7±7.5 yrs	46.9±8.2 yrs	0.106

Anaemia affected 48% of the respondents who had diabetes, with mild, moderate, and severe anemia in 33%, 12%, and 3% of the subjects, respectively. Anaemia affected 25% of the subjects who did not have diabetes, with mild, moderate, and severe anemia in 15%, 9%, and 1% of the subjects, respectively.

Table 2 :Comparison of grades of Anemia in the two groups

Grade of Anemia	Diabetic	Non Diabetic	p value
Mild	33%	15%	0.0008
Moderate	12%	09%	
Severe	03%	01%	

Compared to controls (12.1±1.5 g/dl), individuals with diabetes had significantly lower hemoglobin levels (9.8±2.5 g/dl). Patients with diabetes had significantly decreased RBC parameters, such as PCV and RBC count, whereas significantly greater RDW-CV, MCHC, and MCV were observed.

MCH did not exhibit any discernible variation. Patients with diabetes had a considerably greater mean WBC count and mean lymphocyte count than non-diabetics.

Patients with diabetes had significantly higher mean platelet counts and MPVs than non-diabetics.

Table 3 : Comparison of various haematological parameters in the two groups

Parameter	Diabetics	Non Diabetics	p value
Haemoglobin (g/dl)	9.8±2.5	12.1±1.5	<0.0001
RBC count (10^6/µl)	4.01±1.52	4.82±1.14	<0.0001
PCV (%)	29.4±5.28	36.3±4.82	<0.0001
MCV (fl)	98.53±15.33	82±14.82	<0.0001
MCH (pg)	29.7±5.8	28.3±4.9	0.066
MCHC (g/dl)	37.1±5.3	34.1±6.2	0.0003
RDW (%)	18.8±5.3	16.4±4.2	0.0005
WBC count (X10^3/µl)	8.5±3.3	7.3±2.8	0.0061
ALC (/cmm)	4200±502	3400±600	<0.0001
ANC (/cmm)	6000±840	5800±750	0.077
AMC (/cmm)	650±150	600±250	0.087
AEC (/cmm)	450±270	390±180	0.065
Platelet count (X10^3/µl)	270±150	210±150	0.005
MPV (fl)	13.5±2.3	11.5±2.2	<0.0001

*ALC- Absolute lymphocyte count, ANC- Absolute neutrophil count, AMC-Absolute monocyte count, AEC-Absolute eosinophil count

Table 4 Peripheral Smear findings in the two groups

PS finding	Diabetic	Non Diabetic	p value
Normocytic Normochromic	9	3	0.004
Microcytic Hypochromic	5	7	0.507
Macrocytic	10	3	0.007
Giant platelets	6	1	0.001
Neutrophilia	1	0	0.156
Lymphocytosis	25	1	<0.0001
Eosinophilia	3	1	0.030
Monocytosis	1	0	0.3
Polychromasia	3	1	0.0003
Fragmented RBCs	12	2	0.0001
Burr cells	1	0	0.3

Discussion

The frequency of diabetes mellitus, a complicated metabolic multisystemic disease, is rising significantly. Chronic hyperglycemia causes non-enzymatic glycation of hemoglobin, prothrombin, and fibrinogen, among other blood proteins. This alters the blood's viscosity, flow, red cell deformability, surface charge, erythrocyte aggregation, and other physiochemical characteristics. [11] Additionally, the pro-inflammatory environment linked to diabetes modifies a number of haematological markers.

The hemogram shows the resulting platelet, WBC, and RBC malfunction.

There were 100 participants in each of the two groups in our study. In contrast to research by Ravi Patel, the mean age of those with diabetes was 48.7 years, while that of non-diabetics was 46.9 years. [12]

In the diabetic group, hemoglobin and RBC measures such as RBC count, PCV, and MCHC were significantly lower, whereas MCV and RDW CV showed a considerable rise. Previous research has demonstrated that diabetes, along with its associated hyperglycemia, induces alterations in the body's metabolic and physiochemical makeup, which can operate as an independent risk factor for anemia. [13,14–15] Diabetes has a complicated and diverse etiopathogenesis of anemia. Although it is well known that the erythropoietin pathway plays a role in the development of secondary anemia and that renal failure and anemia are related, it has been noted that patients with diabetes experience anemia much earlier in the course of their disease and that the severity of their anemia increases with the stage of their renal impairment in comparison to non-diabetic patients who experience renal impairment from other causes. [16] These results suggest that anemia in diabetes has a complicated, multiple etiopathogenesis.

Other mechanisms that lead to the development of anemia in these patients include inflammatory meliouris with an increase in cytokines such as IL 6, which negatively impact erythropoiesis; decreased erythropoietin responsiveness; direct toxic effect on hematopoiesis; malfunction in the feedback loop of bone marrow and peripheral blood cells; and accelerated ageing and destruction of red blood cells (RBCs) because of membrane protein glycation,

rigidity, and increased viscosity. [17, 18; 19, 20] ACE inhibitors and metformin are two medications that also cause anemia in people with diabetes. HbA1C measurement is hampered by decreased hemoglobin concentration and rapid red blood cell aging, which makes it difficult to effectively manage hyperglycemia with medication.The development and progression of diabetes's micro- and macrovascular consequences are accelerated by anemia, which increases the morbidity associated with these conditions. [21]

Therefore, treating anemia in diabetes patients can help to prevent a lot of morbidity, which will ultimately improve their quality of life.

Patients with diabetes were found to have considerably increased MCV. Twenty individuals had megaloblastic anemia, which may have been brought on by metformin use or drinking. Additionally, the polychromasia that was observed in 17 patients added to the overall elevated MCV.

Significantly more diabetic patients were found in RDW, which was indicative of decreased erythropoiesis and inflammatory mileu. Some people view RDW as a stand-alone inflammatory sign.

Total and absolute lymphocyte counts had a strong connection with diabetes, despite their normal values. Patients with diabetes had greater absolute neutrophil, eosinophil, and monocyte counts, but no discernible correlation was seen. Higher WBC counts and lymphocytosis in these patients are associated with proinflammatory mileu and oxidative stress, both of which are linked to the onset and progression of numerous angiopathic problems related to diabetes. Workers in epidemiology have proposed that inflammation plays a part in the development of diabetes. Diabetics have abnormal leucocyte function, which increases their risk of recurring infections.

The proportion of diabetes patients with eosinophilia was higher than that of non-diabetics, despite the fact that the absolute eosinophil count did not demonstrate any meaningful association. Their susceptibility to asymptomatic or subclinical fungal infections may be the cause of this.

Diabetic patients had greater MPV and platelet counts than the control group. The bone marrow is prompted to release reserve and immature large platelets as a result of microhemorrhages in the atheromatous plaques. Increased MPV and platelet size fluctuation, which is shown in PDW, are caused by platelet swelling brought on by hyperosmalirity of plasma and platelet degranulation. Diabetes also affects platelet function, which increases the risk of thrombotic events.

Platelet parameters especially elevated MPV reflect the onset and course of atherosclerosis. Additional platelet characteristics have been demonstrated to be correlated with cholesterol and HbA1C levels, which are key factors in determining cardiovascular morbidity.

Conclusion

Conclusively, frequent observation and meticulous evaluation of hematological parameters might be extremely beneficial in anticipating, averting, and postponing numerous problems associated with diabetes.

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