

Changes in CBC, FBG, HbA1c and Coagulation Factors among T1DM Patients

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Abstract:

Type 1 diabetes mellitus is an autoimmune disorder, which destroys the insulin producing beta cells in pancreas. The aim of this study was to measure the changes in CBC, FBG, HbA1c and coagulation factors in adult patients with T1DM and to investigate the effects of HbA1c on PT, PTT, and CBCs. Blood samples were collected from fifty diabetic patients with age range of (18-25 years). Standard procedures, instruments and analytical grade chemicals were used. The obtained results were statically analyzed. The mean values of many variables indicated hematological abnormalities including HbA1C (7.1%), FBG (169 mg/dl), HB (11.2g/dl), MCV (79cells/ML), platelets (313.12), WBCS (6.8cell/cumm), PT (16.8sec) and PTT (43.3sec). Neutrophil, lymphocyte and monocytes showed high mean values. 40% of the cases were found to be anemic. Strong positive correlation was shown between HbA1c and PT whereas FBG showed significant correlation with PPT.

Keywords: T1DM, Abnormalities, Hyperglycemia, HbA1C, coagulation factors.

1. INTRODUCTION

Worldwide the number of adult individuals living with diabetes was estimated by the International Diabetes Federation (2019) as 463million and may reach to 700 million in 2045. The estimated number of children and adolescent affected by T1DM worldwide was 1.1 million (Saeedi, *et al.*, 2019). Type1diabetes mellitus destroys the insulin producing beta cells of pancreas leading to absolute insulin deficiency (Ziaee, A. *et al.*, 2017, N. Saki *et al.*, 2023), whereas, type 2diabetes mellitus results in physical inactivity or obesity (J. Barbieri *et al.*, 2015, E. Torfi, *et al.*, 2024). Hyperglycemia is a primary contributor to the development of various diabetic complications (A. Salsali *et al.*, 2006). Inflammation and disease progression in diabetes potential were suggested by G. Aktas *et al.*, (2018) as indicators of red cell distribution width (RDW), mean platelet volume (MPV), and neutrophil-lymphocyte ratio (NLR). The glycated hemoglobins are hemoglobins with sugar moiety attached to them forming the HbA1fraction within the adult hemoglobin HbA (Abbasi S. *et al.*, 2023). The HbA1c fraction, in particular, serves as a predominant component of HbA1 and provides an estimate of an individual's blood sugar over the previous three months (Wang M. *et al.*, 2021). Adane T. and Getawa S. (2021) reported anemia prevalence as (16.78%) among T1DM patients compared with (22%) among T2DM, linked to obesity, high levels of triglycerides, duration of T2DM and chronic kidney disease (Hizomi Arani R. *et al.*, 2023). Systemic inflammation was described to be

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another cause of anemia (Allende *et al.*, 2021). Atherosclerosis progresses faster and extends more distally in diabetes patients (Jenkins A. *et al.*, 2019). DM increases vascular inflammation and oxidative stress, while, vascular inflammation affects erythropoiesis and red blood cell distribution width (RDW). The global coagulation assays may provide a more complete assessment of an individual's hemostatic profile (Lim *et al.*, 2019). The mean platelet volume (MPV) is useful prognostic biomarker for DM patients. Higher levels of neutrophil-lymphocyte ratio (NLR) associate with poor glycemic control in T2DM patients; therefore it can be used as a screening tool in diabetic follow-up. Anemia was described to be common and may causes under recognized complications in T1DM patients (Grossman *et al.*, 2014).

2. METHODOLOGY

Venous blood samples were collected from fifty patients suffering T1DM at Rabak hospital in White Nile State of Sudan. The participants were 27 females and 23 males with age range of (18-25years). The samples were transformed to EDTA, fluoride, oxalate and sodium nitrate containers. Cell hematology analyzer, Ichroma analyzer, Bio-systems Chemistry analyzer and Coatron M2 were used. The measured variables were, Hb, WBC, RBCs, Hct, MCV, MCH, MCHC, RDWcv, WBC, PLT, MPV, Neutrophil (N), lymphocyte, monocyte count (MX), FBG, HbA1C, PT and PTT. The data included patient's, age, gender, body mass index, duration of DM and medications type. The obtained results were statically analyzed using (SPSS) program.

3. RESULTS AND DISCUSSION

As shown by table (1) many hematological parameters showed low mean values such as, Hb (11.2g/dl), RBCs (4.3%), WBCs (6.8cell/l), and MCV (79cell/cumm). Among the study population (40%), of the patients were anemic and (60%) of them have low MCV values. Therefore anemia can be described as a common disease among the T1DM patients of Rabak hospital. These findings may strongly agree with that, reported by Mbata C. A. *et al.*, (2015), Grossman *et al.*, (2014) and Adane *et al.*, (2021). Anemia causes may include systemic inflammation, suppression of erthropoietin release, medications, renal impairment, altered iron metabolism and hyperglycemia (Allende, *et al.*, 2021, AL-salman *et al.*, 2015). The results showed mean values as, platelets (313 cell/cumm), MPV (9.2 cell/cumm) and RDW (13.8). The circulating platelets were reported to be hyper reactive with increased adhesion, activation and aggregation activity in patients with DM (Randriamboavonjy *et al.*, 2012). However the thrombocytopenia in T1DM increases bruising or bleeding during insulin injection and finger- bricking. In this study high mean values were shown by neutrophil (53.5cell/cumm), lymphocyte (34.7cell/cumm) and monocyte (11cell/cumm). This may disagree with Harsunen *et al.*, (2013) who reported lower WBC, neutrophil, basophil, monocyte and lymphocyte counts in adults who newly diagnosed with T1DM. This may be due to abnormal neutrophil yield and maturation, peripheral consumption or damage and tissue detainment.

Table. 1. Mean values of hematological parameters

Parameters	Minimum	Maximum	Mean	Normal range
HB	5.40	15.00	11.27	13.5- 16
WBCS	3.30	16.60	6.9	4- 11
RBCS	2.10	5.60	4.3	4.5- 6
HCT	17.00	45.00	33.8	37- 52
MCV	68.00	93.00	79.3	80- 100
MCH	22.00	32.00	25.9	27- 32
MCHC	24.00	36.00	32.9	31- 37
RDWcv	10.00	27	13.8	11.5- 15
PLT	153.00	703.0	313.1	150- 450
MPV	7.6	13.0	9.3	7.4- 11.5
N	25.0	77.80	53.5	40- 70
Ly	14.0	59.0	34.7	20- 40
MX	1.80	37	11	2- 8

Table (2) shows high mean values for FBG (162.3M), HbA1C (7.1%), PT (16.88sec) and PTT (43.36 sec). The increase in blood sugar levels was reported to result from beta cells destruction in pancreatic islets (Rakieten N. *et al.*, 1963). The HbA1c was suggested to be tested once every 12 months for the diagnosis of diabetes in high risk –individual adults and up to four times per year (Canberra, 2020). The coagulation factors (PT and PTT) which, showed high means in this study evaluate complications of global coagulation assays in diabetic patients to determine how such combination assays can assist in providing a better individualized cardiovascular disease risk assessment (Torfi, *et al.*, 2024). Antovic, J. P. *et al.*, (2003) reported higher (OHP) in patients with T1DM complications compared with controls, although there were no significant differences in the overall fibrinolytic potential (OF). In this study HbA1c showed significant correlation with PT, whereas, FBG showed significant correlation with PTT. The mean value of HbA1c was statically non-significant with Hb. This finding does not agree with Kalairajan *et al.*, (2019) who described significant correlations between Hb and HBA1c. Urreehanga E. *et al.*, (2018) reported positive association between HbA1c levels and iron deficiency anemia.

Table (2): Mean values of FBG, HbA1c, PT and PTT

Parameter	Minimum	Maximum	Mean	Normal range
FBG	77.00	425	169.2	120-140
HBA1C	4.5	7.15	1.1	Below 5.7%
PT	11.00	26.00	16.88	11-13.5
PTT	25.00	73.00	43.36	25-36

CONCLUSION

Among the studied T1DM patients, anemia was found to be common, where (60%) of the cases showed low MCV and (40%) had low hemoglobin range. High mean values were observed for neutrophil, lymphocyte, monocyte and coagulation factors.

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