A Comparative study of Hematological and biochemical parameters in leukemia patients and healthy persons

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Abstract

Objective: Leukemia is classified as a type of tumor that affects the blood and bone marrow, and is considered a hematopoietic tissue tumor. The four primary forms of leukemia include acute lymphoblastic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), and chronic myeloid leukemia (CML). Aim of the study: This study aimed to compare Hematological analysis and biochemical parameters (kidney, and liver functions test) of leukemia patients and healthy persons. Methods: This study was composed of 40 patients diagnosed with ALL, AML, CLL, and CML and 40 healthy people as a control group. The blood samples were collected to measure the Hematological analysis levels and kidney, liver functions test. Results: there was an increase in the level of ALK of patients with leukemia when compared to the control group and also there was no significance in the levels of urea, creatinine, and sGPT of patients with leukemia when compared with the control group, the statistical analysis showed that there was a decrease in the levels of HCT and HB and also there was no significance in the levels of WBCs, platelets, MCHC, MCH and MCV of patients with leukemia when compared with the control group. Conclusion: In leukemia patients ALK was significantly increase and significantly decrease HCT and HB when compared with healthy persons.

Keywords: Leukemia, WBCs, PLT, HCT, HB, MCV, MCH, MCHC, ALK, and sGPT

1. Introduction

Leukemia is a malignancy that affects the bone marrow and blood, and is characterized by an aggressive proliferation of abnormal white blood cells. It can impair the immune system's functioning and has two forms: acute and chronic leukemia. The rate of disease progression is the distinguishing factor between these two types. In acute leukemia, the malignant white blood cells do not function like normal white blood cells, while in chronic leukemia, they may behave like normal white blood cells, making it difficult to distinguish between them. There are four major types of leukemia, which include Acute Myeloid Leukemia, Acute Lymphoblastic Leukemia, Chronic Myeloid leukemia, and Chronic Lymphocytic leukemia. (Onciu, 2009; Elawad, 2019).

leukemia Diagnosis: There are many ways to diagnose leukemia: Blood tests (Complete blood count, there are many main types of blood cells measured, including: White blood cells, Hematocrit, Platelet count Hemoglobin, Mean Cell Volume, Mean Cell Hemoglobin, Mean cell hemoglobin concentration) (Vogado *et al.*, 2018; Wiley and Sons, 2015), and kidney function test and liver function test: the examination of the blood smear under the microscope is necessary to look for any cancer cells(Hantoosh *et al.*, 2018).

2. Materials and Methods

This study included forty leukemia patients. This study was carried out at the College of Science, department of biology, and random samples of forty healthy people were considered as a control group.

Hematological analysis

Three ml collected from EDTA tubes were transmitted directly to hematological examination, and two ml of blood were collected in a gel tube was centrifuged for 15 min at (8000) RPM used to separate serum for renal, and liver functions analysis directly, the blood samples and serum were placed in a cool box and were then transferred to the laboratory, Hematological parameters were measured automatically by(Fully Automatic 5-Part Sysmex XN-330, Hematology Analyzer, Japan) and estimated as below: (WBCs), (PLT), (HCT),(HB),(MCV),(MCH), (MCHC).

kidney, liver functions analysis

Blood samples were collected and serum was separated to measured levels of serum GPT, ALK, urea, and creatinine concentration measured automatically by (Geno-TEK, Smart-150) Automatic chemistry analyzer, USA.

3. Results

Blood samples were collected and serum was

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separated to measured levels of serum GPT, ALK, urea and creatinine, statistical analysis showed there was increase in the level of ALK with (Mean 345.9, SD 1.4 with Range= 108 U/L -974 U/L) among patients with leukemia when compared to control group that(Mean 170.3, SD 56.5 with Range = 92 U/L -281 U/L), and also there was no significant in the levels of urea, creatinine and sGPT with (Mean 34.4, SD 1.1 with Range = 19 mg/dl -79 mg/dl), (Mean 0.68 ,SD 0.2 with Range = 0.4 mg/dl-1.8 mg/dl) and (Mean14.2, SD 6.5 with Rang = 3 U/L -32 U/L) respectively among patients with leukemia when compared to control group that(Mean 26.3, SD 7.4 with Range= 12 mg/dl -44 mg/dl), (Mean 0.8, SD 0.1 with Range= 0.6 mg/dl -1 mg/dl) and (Mean 26.8, SD 8.8 with Range= 11 U/L -43 U/L) respectively. that statistical analysis showed that there was decrease in the levels of HCT and HB with(Mean 30.7, SD 7.7with Range = 14.7%-46.9%) and(Mean 10.5, SD 2.6 with Range = 5.1g/l-16.4g/l) respectively among patients with leukemia when compared to control group that(Mean 39.3, SD 4.8 with Range = 31.7%-49.2%) and (Mean13.3, SD 1.9 with Range = 8 g/l -16.3 g/l) respectively, and also there was no significant in the levels of WBCs, platelets, MCHC, MCH and MCV that(Mean 8.8, SD 1.0 with Range = 0.1× 10 9 /ul - 6× 10 9 /ul), (Mean 222.5, SD 2.7 with Range = 3× 10 9 /ul -240× 10 9 /ul), (Mean34.3, SD 1.8 with Range= 28.3 g/dl -38.7 g/dl),(Mean 28.2, SD 4.0with Range = 17.6 pg. -34.1 pg.) and (Mean 82.0, SD 10.6 with Range = 57.1 f/l - 111.6 f/l) respectively when compared to control group that (Mean 7.5, SD 1.9 with Range = 4× 10 9 /ul -10.6× 10 9 /ul), (Mean 269.7, SD 61with Range = 152× 10 9 /ul -388× 10 9 /ul), (Mean 34.1, SD 1.6 with Range = 30.9-37), (Mean 28.9, SD 1.7 with Range = 24.2 g/dl -33.1 g/dl)and (Mean 84.2, SD 9.4 with Range = 74.9 f/l -94.3 f/l) respectively as shown in the table (1) and table (2).

Table (1): Patients Laboratory Data

Item	Number	Range	Mean	SD
Blood urea gm./dl	40	19-79	34.4	1.1
Creatinine mg/dl	40	0.4-1.8	0.68	0.2
sGPT U/L	40	3-32	14.2	6.5
ALK. Ph. U/L	40	108-974	345.9	1.4
HCT %	40	14.7-46.9	30.7	7.7
HB g/L	40	5.1-16.4	10.5	2.6
WBC × 10^9/ul	40	0.1-60	8.8	1.0
Platelet × 10^9/ul	40	3-566	222.5	2.7
MCHC g/dl	40	28.3-38.7	34.3	1.8
MCH. pg.	40	17.6-34.1	28.2	4.0
MCV f/l	40	57.1-111.6	82.0	10.6

Table (2): Healthy person(control group) laboratory data

Item	Number	Range	Mean	SD
blood urea gm/dl	40	12.0-44	26.3	7.4
Creatinine mg/dl	40	0.60-1	0.8	0.1
sGPT U/L	40	11.0-43	26.8	8.8
ALKP U/L	40	92.0-281	170.3	56.5
HCT %	40	31.7-49.2	39.3	4.8
HB g/L	40	8.0-16.3	13.1	1.9
WBC × 10 9 /ul	40	4-10.6	7.5	1.9
Platelet × 10 9 /ul	40	152-388	269.7	61.0
MCHC g/dl	40	30.9-37	34.1	1.6
MCH pg	40	24.2-33.1	28.9	1.7
MCV f/l	40	74.9-94.3	84.2	9.4

4. Discussion

The study found that the minimum and mean levels of urea in leukemia patients were not significantly different, which is consistent with the results of a previous study by Kopecna (2001). However, some patients showed an increase in the maximum range of urea. This is believed to be due to the breakdown of nucleic acids from leukemia cells, resulting in increased uric acid levels in the serum. This may serve as a marker of disease aggression. Furthermore, individuals with leukemia may develop hyperuricemia, which can result from a range of complications such as tumor lysis syndrome, adverse drug reactions, and renal impairment. A study has proposed that some patients may experience an elevation in serum uric acid levels as a result of inadequate excretion owing to renal dysfunction (Jumaah et al., 2021).

The range of creatinine levels in leukemia patients was found to be nearly within the normal range. However, low levels of creatinine in the minimum range were associated with systemic inflammation, which is a hallmark of cancer cachexia progression. These findings are consistent with a previous study conducted by Argiles et al. (2019).While that increase in the maximum range of creatinine results agrees with a previous study of Yang *et al* (2021) that high creatinine concentrations may be an indicator of severe renal damage, Studies have shown that the systemic inflammatory state of patients, the decrease of drinking water caused by loss of appetite, and the disrupted electrolyte balance caused by diarrhea induced by intestinal environmental changes can lead to the damage of renal function .The range and mean levels of serum GPT there was normal and not significant in the patient with leukemia as compared to the control, the results agree with a previous study of Kopecna(2001)reported that improved chance for cure and prolonged survival, especially in childhood leukemia, implies the necessity for long term follow up of body systems, effects of therapeutic approaches and different complications are most directly related to the kidney.

Furthermore, the study found that the minimum range of ALK activity was within the normal range. This is consistent with previous studies, such as Lammers et al. (2014), which showed that in some cases of leukemia patients in remission, an increase in the maximum range and mean levels of ALK activity may occur. The elevated ALK activity may result from direct infiltration of leukemia cells into the liver, leading to damage in the mitochondrial and cytoplasmic membranes, or from liver tissue damage caused by a specific immune response.Minimum range and mean levels of HCT are low this is because cancers cause inflammation that decreases red blood cell production, in addition, many chemotherapies are myelosuppressive, meaning they slow down the production of new blood cells by the bone marrow(Gilreath *et al.*, 2014).

The maximum range of HCT is normal because some

remission cases in leukemia patients might be differences in sample size and diagnosis conditions (Borsellino *et al.*, 2022).Maximum range of Hb is high because blood transfusion, a high Hb level is associated with the pretreatment proliferative activity of bone marrow blast cells and, to a lesser extent, with T-cell type of disease, a higher percentage of blasts in the S phase of cell cycle carries a poor prognosis, and that T-cell disease is associated with a higher percentage of cells in S phase, it has a rapidly multiplying malignancy, and they present before the Hb has time to fall(Hann *et al.,* 1981). An elevated red blood cell (RBC) count and higher levels of hemoglobin and hematocrit can be attributed to dehydration (inadequate water intake) or certain medical conditions.(Henny, 1990).Minimum range and mean levels of Hb low this is because anemia due to cancer itself, categorized as anemia of chronic disease, is often seen before or at diagnosis of underlying cancer and may precede the start of myelosuppressive radiation therapy or chemotherapy, chronic anemia of cancer may develop as a result of disease-stimulated production of inflammatory cytokines(interferons, interleukin-1, tumor necrosis factor) (Van Belle, 2004). The minimum range of WBCs low agrees with the previous study of Ahmed *et al* (2012) reported because the immature cells get trapped in the bone marrow and are not detected in blood tests, a low white blood cell count, a decrease in the production of functional leukocytes(white blood cells) weakens the body immune defense.

The maximum range of WBCs high because normally WBCs grow based on body needs, but in the case of leukemia, they are created abnormally and become incorrect, it begins.

when the bone marrow starts to rapidly produce abnormal white blood cells called leukemia cells, they may crowd out normal white blood cells, red blood cells, and platelets, making it hard for the normal cells to do their work (Sahlol et al., 2020). the mean level of WBCs was normal because the patients can have WBCs within the normal range and still have a high percentage of leukemic blasts in the bone marrow (Helenius et al., 2021) and this finding agrees with Sakata et al(2014) these patients often have relatively normal blood cell counts and a lower incidence of organomegaly, this form of presentation can lead to delays in the diagnosis of acute leukemia in adults. The finding of platelets agrees with Bhushan et al(2017) who reported that platelets with leukemia patients were adequate with a count of 325 × 103/μL with few giant platelets, the platelet indices, namely mean platelet volume and platelet large cell ratio was normal. The results of the minimum range of low platelets agree with the study of Kuter, (2022) because the main reason for the minimum range of low platelets to check the platelet count in a cancer patient receiving chemotherapy is to attempt to predict the bleeding risk, symptoms of low platelet count may begin soon after chemotherapy starts, but they are usually at their worst 10–14 days after you first receive chemotherapy.

The maximum range of platelet counts could be high and can be serious if a sign of disease or other health condition, such as cancer or inflammatory bowel disease, the elevated platelet count occurs in response to cytokines, the cytokines interleukin-6 and thrombopoietin stimulate platelet production and extensive invasion of myeloid blast cells (Saglio et al., 2005). The results agree with Chulilla et al (2009) that the mean MCHC value may be normal with many types of anemia (normochromic anemias), such as bone marrow failure by chemotherapy or cancer infiltrates, and the results agree with the study of (Khazaal et al., 2019). The minimum range of MCHC low in this study agrees with the previous study that AML is characterized by mutations of the genes involved in hematopoiesis, which led to the hematological investigations performed on the MCHC being reduced (Jain et al., 2021).

The maximum range of MCHC a high called hyperchromia can mean that there is a higher hemoglobin concentration in red blood cells than usual (Eldridge, 2022). The mean value and maximum range of mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) are nearly normal and were not different from normal values. The minimum range of MCV and MCH were low levels agreeing with the previous study of Sasaki et al (2016) It was noted that cancer-related anemia is associated with a reduction in RBC count. However, low levels of RBCs, hemoglobin, and hematocrit can also result from other factors such as significant blood loss, malnutrition (inadequate nutrient intake), kidney disease, liver disease (cirrhosis), cancer, and certain medications used to treat cancer.

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