Research Article

Correlation of CBC Parameters and Immunophenotyping in Acute Lymphoblastic Leukaemia Patients in Khartoum State, Sudan

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Abstract:

Background: Acute lymphoblastic leukemia, a malignant disorder of lymphoid progenitor cells, affects both children and adults, with peak prevalence between the ages of 2 and 5 years. ***Objectives*:** This study aimed to estimate the complete blood count and immunophenotyping and correlate the parameter results among acute lymphoblastic leukemia Sudanese patients. ***Methods*:** An analytical cross-sectional study was conducted in Khartoum Hospital for Oncology and Flow Cytometry Centre from January to April 2023 on a total of one hundred fifty venous blood samples collected from acute lymphoblastic leukemia patients. A complete hemogram was then done using an automated cell counter (Mindray BC 6800) and flow cytometry. ***Results*:** For compassion of CBC between B cells and T cells type, WBCS was significantly higher in T cell type compared to B cell type (162.2 ± 25.0 vs 43.3 ± 4.8)p-value 0.000* respectively, RBCS did not significantly differ in T cell type and B cell type (2.7 ± 0.9 vs 2.7 ± 0.8)p-value 0.843, platelet was not significantly differed in T cell type and B cell type (45.4 ± 4.3 vs 51.3 ± 7.2)p-value 0.525 respectively, HB did not significantly differ in T cell type and B cell type (8.7 ± 0.6 vs 8.7 ± 0.6)p-value 0.942 respectively, Blast was not significantly differed in T cell type and B cell type (68.3 ± 19.6 vs 60.9 ± 18.3) p-value 0.052, For correlations of age with CBC, all parameters were not significantly correlated with age. ***Conclusion*:** The study concludes that anemia and thrombocytopenia were observed in almost all patients, white blood cells were significantly higher in the T cell type compared to the B cell type.

Keywords: Acute Lymphoblastic Leukemia, Correlation, CBC, Immunophenotyping, Laboratory parameters, Sudan.

Introduction:

Acute leukemia, comprising acute myeloblastic leukemia (AML) and acute lymphoblastic leukemia (ALL), represents a clonal, malignant transformation of blood-forming cells that arise from the bone marrow or lymphoid organs and are often associated with fundamental genetic abnormalities. The clinical course is rapid, and the outcome is fatal within three months if untreated **[1].** Leukaemia is a common malignancy around the world, comprising 30% of malignant tumors in children **[2].** Acute lymphoblastic leukemia (ALL) is a neoplastic proliferation of lymphoid cells arrested at a premature stage of differentiation. It can occur in both children and adults and accounts for 80% of all cases of childhood leukemia and 20% of adult cases **[3].** Acute lymphoblastic leukemia occurs before the age of 15 years and 19% among those younger than age 20 years **[4]**, with peak prevalence between the ages of 2 and 5 years of age **[5],** and again after the age of 50 years **[6].** Males are affected more often than females, except in infants, the difference being greater among pubertal children **[7].** Steady progress in the development of effective treatments has led to a cure rate of more than 80% in children **[8].** It can be diagnosed with less than 20% blasts if specific leukemia-associated cytogenetic or molecular genetic abnormalities are present **[9].** The French-American-British Cooperative Working Group defines three categories of lymphoblasts, i.e., L1, L2, and L3 **[10].** This classification cannot accurately distinguish between ALL and non-lymphoid acute leukemia and has no prognostic or therapeutic relevance with contemporary therapy **[11].** Because leukemic lymphoblasts lack specific morphologic and cytochemical features, the immunophenotype is assessed by flow cytometry. CBC and immunophenotyping are the most important techniques used in the diagnosis of acute lymphoblastic leukemia. A full blood count (FBC), sometimes referred to as a complete blood count (CBC), is a series of laboratory tests used in medicine that reveal details about the cells in a patient's blood. The CBC shows the concentration of hemoglobin, the hematocrit (the volume proportion of red blood cells), and the counts of white blood cells, red blood cells, and platelets. A white blood cell differential, which counts the various types of white blood cells, may be included in addition to the red blood cell indices, which show the average size and hemoglobin concentration of red blood cells. The CBC can be used to monitor health or diagnose disorders, and it is frequently performed as part of a medical assessment. The outcomes are analyzed through comparison. Conditions like leukemia, anemia, and thrombocytopenia The CBC is usually performed by an automated hematology analyzer, which counts cells and collects information on their size and structure. The concentration of hemoglobin is measured, and the red blood cell indices are calculated from measurements of red blood cells and hemoglobin **[12].** Flow cytometer: Flow cytometric immunophenotyping (FCI)

is an essential component in the diagnostic evaluation of acute leukemias. By enabling a comprehensive assessment of relevant surface-membrane and intracellular antigens expressed by leukemic cells, FCI facilitates the identification and phenotypic characterization of blasts, permitting assignment of lineage, assessment of potential therapeutic targets, and prediction of certain genetic lesions **[13].**

Materials and methods:

Study Design:

This is a cross-sectional hospital-based study.

Study area:

The study was conducted in the flow cytometer center for the diagnosis of leukemia and lymphoma in Khartoum State.

Study period:

This study was conducted over a period of four months, running between January and April 2023.

Study population:

A patient diagnosed with acute lymphoblastic leukemia.

Inclusion criteria:

Patients with acute lymphoblastic leukemia.

Exclusion criteria:

All patients who received blood transfusions in the last 72 hours.

Data collection:

Data was collected using a structured questionnaire; the required information included age, sex, diagnosis, and laboratory findings.

Ethical consideration:

The proposal was submitted to the National University Research Committee and informed written consent was collected from each patient.

Method for Sample Collection:

After calculating from the previous study, we found that 150 samples would cover our research in a way that would help us clarify the purpose of the study. Before collection, a local antiseptic (70% alcohol) will be used to disinfect the skin and venous blood. 5 ml of blood from the patient (3.2 ml) in Ethylene Diamine Tetra-acetic Acid (EDTA) and. labeled with the subject's age, sex, and identification number, then examined the cell counter, and flow cytometer device.

Method for Complete Cell Count (CBC):

The Principle of Coulter the blood cells that are not very conductive are suspended in a liquid conductive diluent. An electric field formed by two electrodes is transferred through the diluent. A little opening allows the liquid to pass through. The impedance, or resistance, of the electrical circuit between the electrodes, briefly increases as each particle passes through the aperture. One can measure the pulse produced by the increase in impedance. The count of blood cells is equal to the number of pulses. The pulse's amplitude, or height, is equivalent to the cell's volume.

Method for flow cytometer:

Principle of flow cytometry: The basic principle of flow cytometry is the passage of cells in a single file in front of a laser so they can be detected, counted, and sorted. Cell

components are fluorescently labeled and then excited by the laser to emit light at varying wavelengths. After the samples were collected in an Ethylene Diamine Tetra-acetic Acid (EDTA) anticoagulant tube, the blood was mixed with antibodies (according to the type of cell you searched for) to stain the sample and allow it to be pinched. The red blood cell was then removed by lysis. The remaining sample is passing through a laser beam. The photomultiplier tubes detect the light at various angles, and the size and internal components can be determined. The data are electrochemically stored for analysis and can be displayed in the form of a two-dimensional dot plot.

Data Analysis:

The data obtained through the study were entered and analyzed by computer using Microsoft Office Excel and the SPSS statistical program to calculate the mean, standard deviation, and *P-value* by t-test. P<0.05 was considered statistically significant.

Results:

This cross-sectional study included 150 patients who were diagnosed with acute lymphoblastic leukemia. Age ranged from 2-78 years with a mean of 20.7± 1.5, WBCS ranged from 1.4-690 (109/l) with a mean of 6 7.9± 7.5, RBCS ranged from 0.9-4.5 (1012/l) with a mean of 2.7± 0.8, platelets ranged from 7-339 (109/l) with a mean of 46.6± 3.7, HB ranged from 2.5-71 (g/dl) with a mean of 8.7 ± 5.6, Blast ranged from 21-97% with a mean of 62.5± 18.8) **(Table 1).** For gender distribution, there were 100 males (66.7%) and 50 females (33.3%). **(Table 2).** According to cell type, the majority were B cells, 119 (79.3%), and 31 (20.7%) were T cells **(Table 3).** For compassion of CBC between B cells and T cell type, WBCS was significantly higher in T cell type compared to B cell type (162.2 ± 25.0 vs 43.3 ± 4.8) *P-value* 0.000* respectively, RBCS did not significantly differ in T cell type and B cell type (2.7 ± 0.9 vs 2.7 ± 0.8) *P-value* 0.843, platelet was not significantly differed in T cell type and B cell type (45.4 ± 4.3 vs 51.3 ± 7.2) *P-value* 0.525 respectively, HB did not significantly differ in T cell type and B cell type (8.7 ± 0.6 vs 8.7 ± 0.6) *P-value* 0.942 respectively, Blast was not significantly differed in T cell type and B cell type (68.3 ± 19.6 vs 60.9 ± 18.3) *P-value* 0.052 respectively **(Table 4).** For compassion of CBC between males and females, WBCS did not significantly differ in males and females (59.6 ± 7.6 vs 84.5 ± 16.4) *P-value* 0 .117 respectively, RBCS did not significantly differ in males and females (2.8 ± 0.8 vs 2.6 ± 0.9) *P-value* 0.178 respectively, platelet was significantly higher in female compared to male (61.9 ± 8.9 vs 38.9 ± 3.2) *P-value* 0.018 respectively, HB was not significantly differed male and female (8.5 ± 2.3 vs 9.2 ± 1 .3) *P-value* 0.577 respectively, Blast was significantly higher in female compared to male (67.7 ± 19.3 vs 59.9 ± 18.0) *P-value* 0.0 15 respectively **(Table 5).** For correlations of age with CBC, all parameters were not significantly correlated with age **(Table 6).**

Table 1: Descriptive Statistics of Age and CBC

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	150	2	78	20.7	1.5
WBCs (10^9/l)	150	1.4	690.0	67.9	7.5
RBCs (10^{12}/l)	150	0.97	4.51	2.7	0.8
Platelets (10^9/l)	150	7	339	46.6	3.7
Hb (g/dl)	150	2.5	71.0	8.7	5.6
Blast (%)	150	21	97	62.5	18.8

Table 2: Frequency of patients according to gender

Gender	Frequency	Percent (%)
Male	100	66.7
Female	50	33.3
Total	**150**	**100.0**

Table 3: Distribution of cell type in ALL

Cell type	Frequency	Percent (%)
B Cells	119	79.3
T Cells	31	20.7
Total	**150**	**100.0**

Table 4: Compassion of CBC between B cells and T cells type of ALL

Parameters	Cell type		*P. value*
	B (n=119)	T (n=31)	
WBCs (10^9/l)	43.3 ± 4.8	162.2 ± 25.0	0.000
RBCs (10^{12}/l)	2.7 ± 0.8	2.7 ± 0.9	0.843
Platelets (10^9/l)	45.4 ± 4.3	51.3 ± 7.2	0.525
Hb (g/dl)	8.7 ± 0.6	8.6 ± 2.7	0.942
Blast (%)	60.9 ± 18.3	68.3 ± 19.6	0.052

Table 5: Compassion of CBC between males and females of ALL

Parameters	Gender		*P. value*
	Male (n=100)	Female (n=50)	
WBCs (10^9/l)	59.6 ± 7.6	84.5 ± 16.4	0.117
RBCs (10^{12}/l)	2.8 ± 0.8	2.6 ± 0.9	0.178
Platelets (10^9/l)	38.9 ± 3.2	61.9 ± 8.9	0.018
Hb (g/dl)	8.5 ± 2.3	9.2 ± 1.3	0.577
Blast (%)	59.9 ± 18.0	67.7 ± 19.3	0.015

Table 6: Correlations of age with CBC

Parameters	Correlations	Age
WBCs (10^9/l)	Pearson Correlation	0.023
	P. value	0.782
RBCs (10^{12}/l)	Pearson Correlation	0.160
	P. value	0.051
Platelets (10^9/l)	Pearson Correlation	0.106
	P. value	0.198
Hb (g/dl)	Pearson Correlation	0.016
	P. value	0.849
Blast (%)	Pearson Correlation	0.153
	P. value	0.061

Discussion:

It is highly crucial to be aware of the varying spectrum of these data since timely diagnosis of ALL and maximization of the chance for cure depends on accurate interpretation of CBC results, awareness of early symptoms, and physical examination identification of key markers. This study aimed to assess CBC among Sudanese with acute lymphoblastic leukemia in Khartoum State. Anemia at diagnosis was present in most of our patients. Given that this finding is significantly greater than that found in studies from rich nations, it may be connected to delayed diagnosis. In this respect, in a recent study, anemia was diagnosed in 85% of cases, almost the same proportion as the present research. The current study found that the mean of RBCs, platelet count, Hb, and blast cells did not differ statistically significantly, while the comparison according to the ALL subtype revealed a significantly higher mean total white blood count among patients with T-ALL than those with B-ALL. This is consistent with a study from Canada in 2012 as well as that reported in China in 2021**[14],** which reported that patients with T-ALL showed significant Additionally, we concur with two studies from Brazil in 2015 **[15],** and Iraq in 2018 **[16]**, all of which discovered that T-ALL has a much higher total white blood cell count than B-ALL. In the current study, females have a slightly higher platelet count and blast than males; this finding also agrees with a study in Iran in 2014 **[17].** According to age, all parameters were not significantly correlated with age; this finding also agrees with a study in Egypt in 2010 **[18].** Certain data were significantly different in some cases from what was previously expected; this heterogeneity is most likely multifactorial and can be a proxy for factors such as time to diagnosis, various mutations and/or polymorphisms involved in the pathogenesis of ALL, geographic location, and other biological influences that may have an impact on the clinical course of the disease.

Conclusion:

The study concluded that anemia and thrombocytopenia were observed in almost all patients, and white blood cells were significantly higher in T cell type than in B.

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Conflict of Interest:
The author has affirmed that there are no conflicting interests.

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