

## The First CBC in Diagnosis of childhood acute lymphoblastic leukemia

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**Abstract:** Leukemias are the most common malignant disorders in children, and acute lymphoblastic leukemia is the most prevalent form of childhood leukemia. The first diagnostic test for leukemic patients requested by general physicians or pediatrics is the complete blood count (CBC). This study was conducted to evaluate the results of the first CBC of children suffering from leukemia.

this was a descriptive cross-sectional study. Leukemic patients' data admitted to pediatric hematology-oncology ward of Shohada Tajrish Hospital between 1981 and 2009 formed the basis for our study. Sample population included one-month-old to fourteen-year-old children diagnosed with acute lymphocytic leukemia. Those with diseases influencing CBC test were excluded from the study. First, CBC test of the patients were evaluated and analyzed by SPSS software.

97 patients were collected. The mean age of the patients was 74.2±48.3 months, and 50.5% were female and 49.5% were male. Among the 97 patients, 90.7% had neutropenia, 89.7% had thrombocytopenia, 89.7% had anemia, 77.3% had pancytopenia. Leukocytosis was detected in 39%, blast was detected in 24.7%, eosinophilia was detected in 4.13%, and NRBC was detected in 3.1% of the participants. 3 patients (3.1%) were detected with normal CBC and 7 patients (7.2%) were detected with abnormality in one type of cell. There was a strong correlation between prognosis and RBC count, WBC count, lymphocyte count, platelet count, hemoglobin and hematocrit concentration and MCV level.

this study showed that although a few patients with ALL may have normal CBC or a CBC with minor changes, diagnostic suspicion of ALL could be possible by careful checking of CBC. Furthermore, this diagnostic test is a simple, available, and reasonable test.

**Key words:** ALL, CBC, childhood.

### 1. Introduction

Leukemias are the most common childhood malignant neoplasms and account for 41% of all malignancies in children under 15 (1). The incidence rate of leukemia in the USA is 4 per 100000 children (2). Acute Lymphoblastic leukemia (ALL) accounts for almost 77% of all leukemias (3). Leukemias

impose a huge burden on healthcare systems and societies. According to official statistics of the Ministry of Health and Medical Education of Iran, cancer accounts for 3.7% of all deaths in 1 to 5-month-old children; and leukemias account for 1.4% of all deaths and 38% of cancer-related deaths which is the highest cancer-related death rate. Cancers account for 10.6% of all deaths in 5 to 14-year-old

children which is the second leading cause of death in this age group after accidents. Leukemias account for 3.8% of all deaths and 35% of all cancer-related deaths in this age group (4).

ALL may have different clinical manifestations before being detected (3) and often the patients do not develop specific symptoms at the beginning. The symptoms are anorexia, fatigue, irritation, remittent low grade fever, joint pain, and infection of upper respiratory system which are of low sensitivity and specificity in diagnosis of the disease. Development of the disease is associated with more specific symptoms such as pallor, bruises, under skin bleeding, and nose bleeding (5,6). At this stage individuals go to general physicians and pediatrics and the disease will be detected by peripheral blood test and CBC. ALL is primarily detected by peripheral blood which is a sign of bone marrow defect (6). Most of the patients would be affected by anemia and thrombocytopenia. Leukemic cells are not detected by routine laboratory tests and for most cases the complete leucocyte count is less than 10000 leucocytes per microliter. Increased number of leucocyte cells in peripheral blood results in manifestation of blast cells (7,8). Although ALL is diagnosed when bone marrow evaluation shows that more than 25% of all marrow bone cells are consistent lymphoblast (9), the first test requested by general physicians or pediatricians is CBC (10). To detect ALL, the results of CBC in patients with leukemia are very effective. The importance of CBC test for leukemias detection (especially ALL) is due to the fact that the CBC is common, available, reasonable, and the specimens can be easily taken (11). Precise evaluation of the results of CBC, especially unexpected results, would be effective in early detection and treatment of the disease (12). In this study, we aimed to investigate the results of the first CBC of the patients with ALL.

## 2. Methods and materials

This was a descriptive analytical cross-sectional study. The sample population was consisted of one-month-old to fourteen-year-old children with ALL admitted to Shohada Tajrish Hospital. One-month-old to fourteen-year-old patients with ALL having clinical records in Shohada Tajrish Hospital including their first reliable diagnostic CBC were included in the study. Patients affected by thalassemias, malnutrition, ITP, and other diseases that could have influence on the results of the study were excluded from the study.

All patients with ALL admitted to Shohada Tajrish Hospital between 1981 and 2009 were included in the

study. Considering the literature,  $d=0.07$ , and  $\alpha=0.05$ , a sample size of 70 participants was required. The clinical records of the one-month-old to fourteen-year-old cases with ALL admitted to Shohada Tajrish Hospital between 1360 and 1388 were collected. The patients' data such as sex, age (at the diagnosis time), disease outcome, CBC, and abnormal findings like blast, anemia, neutropenia, leukocytosis, thrombocytopenia, eosinophilia, and pancytopenia were gathered. Then the data was encoded and analyzed by SPSS release 11.0.

## 3. Results

97 cases with ALL who met inclusion criteria were studied. The mean age of the patients was  $74.2 \pm 48.3$  months (6 years and 2.2 months old) with a range from 4 to 156 months. 49 cases were female (50.5%) and 48 cases were male (49.5%). 44 cases (5.4%) cured, 33 cases (34%) were receiving treatment, and 20 cases (20.6%) died. (Table 1)

The patients' CBC was conformed to the sex and age of them and the results were the following: 87 patients (89.7%) with anemia (HB level being -2 standard deviation below the mean for sex and age), 88 patients (90.75) with neutropenia, 38 patients (39.2%) with leukocytosis, 87 patients (89.7%) with thrombocytopenia, 4 patients (4.1%) with eosinophilia, and 75 patients (77.3%) with pancytopenia (among the 3 types of blood cells, 2 types were decreased). Also 15 cases (15.5%) and 24 cases (24.7%) were detected with leucopenia and blast, respectively. CBC of 3 patients (3.1%) in the 5-9 age range was normal (2 males, 1 female). In 7 patients (7.2%) in the 1-4 age group solely one type of blood cells was decreased (4 males and 3 females); 4 of them (57.1%) were detected solely with neutropenia, 2 of them (28.6%) were detected solely with leukocytosis, and 1 of them (14.3%) was detected solely with thrombocytopenia. In 13 patients (13.4%) two types of blood cells were decreased. Also, 2 patients (15.4%) had anemia and thrombocytopenia, 2 patients (15.4%) had anemia and neutropenia, 4 patients (30.8%) had neutropenia and thrombocytopenia, 2 patients (15.4%) had neutropenia and leucopenia, 1 patient (7.66%) had neutropenia and blast, 1 patient (7.66%) had leukocytosis and thrombocytopenia, 1 patient (7.66%) had thrombocytopenia and blast. Among the 13 patients, 7 cases (53.8%) were female and 6 cases (46.2%) were male and 2 cases (15.4%) were 10 years old and older, 3 cases (23%) ranged from 5-9 years and 8 patients (61.5%) ranged from 1-4 years. (table 2, 3)

**Table 1: Table 1. Mean  $\pm$  SD level of the patients**

CBC	Mean± SD
RBC	4635000 ± 534400
WBC	21266 ± 47471
Platelet	72768 ± 64715
Neutrophil	1251 ± 1857
Neutrophil/ WBC	11.988 ± .13
Lymphocyte	20003 ± 47634
Lymphocyte/ WBC	84.7 ± 12.2
HB	27.55 ± 2.7
HCT	24.5 ± 7.1
MCV	86.5 ± 9.6
MCH	3.614 ± .28
MCHC	32.05 ± 2.46

**Table 2. Mean± SD level of the patients based on final outcomes**

CBC	Cured patients	Under therapy	Died patients	P value
RBC	6229 ± 7146	3652 ± 552	2260 ± 604	0.12
WBC	11462 ± 8630	8613 ± 6377	61750 ± 92113	001.0<
Neutrophil count	1705 ± 2644	975 ± 868	801 ± 549	117.0
Neutrophil %	1.5 ± 13.16	9.6 ± 11.12	5 ± 718.10	138.0
Lymphocytecount	7470 ± 6258	10498 ± 7899	60753 ± 92552	001.0<
Lymphocyte%	8.8 ± 12.82	6.9 ± 12.85	7.87 ± 9	364.0
platelet	67886 ± 51205	110757 ± 67245	20825 ± 5866	001.0<
HB	4.1 ± 2.7	8.7 ± 1.8	7.3 ± 1.6	001.0<
HCT	4.3 ± 8.23	3.7 ± 4.28	6.3 ± 3.20	001.0<
MCV	5.2 ± 10.88	9.7 ± 2.81	6.7 ± 11.90	003.0
MCH	3.2 ± 3.28	7.01 ± 4.28	97.2 ± 0.28	973.0
MCHC	31.9 ± 1.5	32.5 ± 2.6	31.6 ± 4.4	0.466

**Table3 Abnormal findings in CBC level of the patients based on final outcomes**

Abnormal findings	Cured patients	Under therapy	Died patients	P value
Blast	20.5%	30.3%	25%	612.0
Anemia	88.6%	84.8%	100%	203.0
Neutropenia	100%	87.9%	75%	005.0
Lukocytosis	34.1%	39.4%	50%	482.0
Thrombocytopenia	88.6%	84.8%	100%	203.0
Eosinophilia	0	12.1%	0	017.0
Pancytopenia	81.8%	72.7%	75%	617.0
leucopenia	11.4%	15.2%	25%	0.375

#### 4. Discussions

The results revealed that most of the cases ranged from 5-7 years and no difference was observed between males and females in being affected with ALL. 96.9% of the cases had abnormal CBC results and only 3 cases (3.1%) had normal CBC results; and also NRBCs were detected in 3 patients' blood. The most common CBC abnormal results were: neutropenia (90.7%), anemia (89.7%), thrombocytopenia (89.7%), and pancytopenia (77.3%). This study showed that in 77.3% of the patients more than 2 types of blood cells were reduced, in 7.2% of the patients 1 type of blood cells was reduced, and in 13.4% of the patients 2 types of

bloodcells were reduced. The most prevalent CBC abnormal results were neutropenia, anemia, and thrombocytopenia. Boissel et al. (5) reported that anemia, thrombocytopenia, and neutropenia were the most common CBC abnormal results. Also, Belson et al. (6) reported that 90% of the cases had thrombocytopenia.

Our study revealed that eosinophilia and leucopenia were not common CBC abnormal results of the patients, and also leukocytosis was not very common. In addition, only 24.7% of the patients were detected with blast. Winick et al. and Pui et al. reported that blast and leukocytosis were not prevalent CBC abnormal results of the cases (9-7).

The results also showed that there was not as significant difference between the number of WBC

in blood and prognosis. The cases with WBC less than 10000 had lower mortality rate, but the cases with WBC more than 50000 had higher mortality rate. These results were in concordance with Browitz et al. and Han et al. (10,11).

This study revealed that in the patients cured from the disease the number of RBC was more compared with other patients. This result was not supported or rejected by previous literature. Often the large number of WBC in the dead patients was due to the large number of lymphocytes in blood. Also, dead patients had the lowest level of platelets, hemoglobin, and neutrophils. These results were in concordance with previous reports such as Vrooman et al. (3,6,12). In this study no significant correlation was observed between thrombocytopenia, blast, pancytopenia and death or cure of the patients. These results were not in concordance with the results reported by Reddy et al. and Onciu et al. (14,13).

### 5. Suggestions

Due to the fact that to reach a firm conclusion on results of such studies it is required to collect a large size sample and patients with fatal diseases such as cancers should be monitored continuously, it is suggested that a data base on children affected with cancers including their demographic data such as clinical and Para clinical information, and disease outcomes should be set up to explore risk factors causing disease and death and estimate the burden of the disease on the society.

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