ZEUGMA BIOLOGICAL SCIENCE

ZEUGMA
BIOLOGICAL SCIENCE

2025
v:6 n:1 p:61-67

Evaluation of Complete Blood Count in Chronic Lymphoid Leukemia Patients

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Abstract

Chronic Lymphoid Leukemia (CLL) is characterized by the uncontrolled proliferation of lymphocytes, usually in the elderly, which can lead to various hematological abnormalities in patients. Analysis of hematological parameters is very important for the diagnosis, prognosis, and monitoring of treatment response in CLL. This study aimed to compare the complete blood count (CBC) parameters of CLL patients with a healthy control group. The study included 50 patients diagnosed with CLL and 50 healthy controls without a history of cancer. CBC parameters (WBC, RBC, HGB, HCT, MCV, MCH, MCHC, RDW, RDW-SD, PDW, PLT, MPV, PCT, NEU%, LYM%, MONO%, EOS%, BASO%, NEU#, LYM#, MONO#, EOS#, BASO#, NRBC#) of CLL patients and control group were statistically compared. According to the analysis results, no significant difference was found between MCV, RDW, RDW-SD, PDW, MPV, BASO%, NEU#, and EOS# values of the patient and control groups ($p>0.05$). However, WBC, RBC, HGB, HCT, LYM%, MONO%, LYM#, MONO#, BASO#, and NRBC# values of the patient group were significantly higher relative to the control group ($p<0.05$). MCH, MCHC, PLT, PCT, NEU%, and EOS% parameters were significantly higher in the control group relative to the patient group ($p<0.05$). As a result, significant differences were observed in some CBC parameters between patients and the control groups. Particularly, the significant difference observed in some parameters emphasizes that the hematological profile of CLL can be used in the diagnosis and monitoring processes. Our findings support the importance of detailed analysis of CBC parameters for a better understanding of CLL.

Keywords: CLL, Prognosis, CBC, Leukemia, Hematological parameters

Introduction

Chronic Lymphoid Leukemia (CLL) is a type of cancer that occurs as a result of the accumulation of abnormal lymphocytes in the bone marrow and impairs the functions of the immune system (Padmanabhan et al., 2023). CLL is the most prevalent of leukemia in adults in Western countries and its clinical course is highly variable. This variability greatly affects treatment strategies and survival processes (Puiggros et al., 2014).

Complete blood count (CBC) functions as a basic test in the diagnosis of hematological and non-hematological conditions (Lokwani, 2013; Masternak et al., 2020). This test provides important information about the blood and partly about the bone marrow. It also gives direct or indirect clues about the health status of various systems of the body. CBC is considered an important indicator of the functioning of the bone marrow where blood cells are produced. It is easily obtainable, can be applied rapidly, has a low cost, and allows the evaluation of the response to treatment by making serial measurements (Lokwani, 2013). The extent of CBC

https://doi.org/10.55549/zbs.1586463

may vary depending on the characteristics of the automated blood count devices used and the laboratories performing the test. Usually, CBC includes erythrocyte and leukocyte counts, standard erythrocyte indices (MCV, MCHC, MCH, RDW), hematocrit (HCT), hemoglobin (HGB), and platelet count. Laboratories with more advanced blood counting equipment may include additional parameters such as erythroblast count, leucocyte formula, reticulocyte count, immature granulocytes, and platelet indices in the CBC report (Köroğlu et al., 2014). One of the most frequently requested tests by clinicians, CBC is used to screen, diagnose or monitor a wide range of diseases (Seo et al., 2022; Rivera et al., 2023). For example, an increase or decrease in white blood cells (WBC) in the results of these tests may indicate diseases such as leukaemia, a decrease in platelet count may be associated with conditions such as liver cirrhosis, while a low hemoglobin (HGB) level may indicate anaemia.(Seo et al., 2022).Since most patients with CLL are asymptomatic, most diagnoses are made by incidental detection of lymphocytosis in routine complete blood counts (Rodrigues et al., 2016; Devi et al., 2022).

In this study, the hematological parameters of CLL patients were evaluated in comparison with the healthy control group. The study aims to reveal the importance of the differences in hematological parameters of CLL in the diagnosis and treatment monitoring of the disease.

Materials & methods

Local ethics committee approval was obtained for the study with protocol number 2021/163. In our study, 50 individuals over 18 years of age who were admitted to the Department of Haematology of Gaziantep SANKO University Hospital and diagnosed with Chronic Lymphoid Leukaemia were included as the patient group and 50 healthy individuals over 18 years of age residing in Gaziantep and without a history of cancer were included as the control group.

Statistical Analysis

All statistical analyses were performed using the SPSS 23.0 package program. Data were expressed as mean ± standard deviation and median, and qualitative data were expressed as a ratio (%). Nonparametric methods were preferred in statistical analysis. Spearman's rho coefficient was used to calculate correlation, Mann Whitney U test was used for analyses of variables consisting of two categories, and Kruskal Wallis H test was used for analyses of variables consisting of more than 2 categories. $p<0.05$ was considered statistically significant.

Results

Characteristics of CLL patients; In this study, complete blood count results of a total of 50 patients with CLL and 50 healthy subjects were used. Of these patients, 58% were male, 42% were female and the mean age was 60.4±10 years. 4% of the patients were smokers and no patient used alcohol. 10% of the patients had a family history of cancer. 66% had other existing diseases. According to the Rai staging system, 24% of the patients were in stage 0, 44% were in stages 1, 15% and 2, and 2% were in stage 3. There were no patients in stage IV. In the control group, 58% were male and 42% were female and the mean age was 53.7±12.7 years. Demographic data of the patient and control groups are summarised in Table 1.

As a result of the statistical analysis, there was no significant difference between the MCV, RDW, RDW-SD, PDW, MPV, BASO%, NEU#, and EOS# values of the patient and control groups ($p>0.05$), while a significant difference was found between the other values ($p<0.05$). Accordingly, WBC, RBC, HGB, HCT, LYM%, MONO%, LYM#, MONO#, BASO#, and NRBC# values of the patient group were significantly higher relative to the control group ($p<0.05$). MCH, MCHC, PLT, PCT, NEU%, and EOS% parameters were significantly higher

https://doi.org/10.55549/zbs.1586463

in the control group relative to the patient group ($p<0.05$). Table 2 shows the comparison of blood values of the patient and control groups.

Table 1. Demographic data of CLL patients and healthy individuals.

FEATURES		**Patient (N=50, %)**	**Control (N=50, %)**
Gender	Male	29 (58%)	29 (58%)
	Female	21 (42%)	21 (42%)
Cigarette smoking	Yes	2 (4%)	-
	No	48 (96%)	-
Rai's classification	Stage 0	12 (24%)	-
	Stage I	22 (44%)	-
	Stage II	15 (30%)	
	Stage III	1 (2%)	-
Other Present Disease(s)	Yes	33 (66%)	-
	No	17 (34%)	-
Family History of Cancer	Yes	5 (10%)	-
	No	45 (90%)	-

Table 2. Comparison of Blood Values of Patient and Control Group

	Patient		**Control**		
	Mean ± SD	**Median**	**Mean ± SD**	**Median**	**p**
WBC	41.10 ± 57.48	25.06	7.43 ± 2.60	7.02	***0.000***
RBC	4.81 ± 0.61	4.90	4.31 ± 0.69	4.40	***0.000***
HGB	13.64 ± 1.88	13.65	12.70 ± 1.92	12.90	***0.035***
HCT	42.16 ± 4.85	42.00	37.11 ± 7.29	37.90	***0.000***
MCV	88.21 ± 7.27	88.15	88.32 ± 6.04	88.45	0.697
MCH	28.44 ± 2.97	28.95	29.60 ± 2.30	29.70	***0.037***
MCHC	31.63± 4.77	32.35	33.61 ± 1.35	33.80	***0.000***
RDW	14.36 ± 1.72	13.80	14.71 ± 2.04	13.95	0.714
RDW-SD	45.24 ± 7.07	45.00	46.86 ± 6.45	46.00	0.351
PDW	12.70 ± 2.59	12.65	12.17 ± 2.17	12.10	0.217
PLT	230.68 ± 87.59	214.50	258.84 ± 76.39	270.00	***0.025***
MPV	10.18 ± 1.33	10.30	10.51 ± 0.91	10.60	0.348
PCT	0.23 ± 0.09	0.23	0.28 ± 0.08	0.28	***0.001***
NEU%	23.07 ± 14.43	20.80	63.24 ± 10.09	62.25	***0.000***
LYM%	69.67 ± 16.91	73.40	25.10 ± 9.17	25.60	***0.000***
MONO%	2.11 ± 2.89	0.88	0.60 ± 0.25	0.54	***0.000***
EOS%	1.14 ± 2.41	0.60	3.06 ± 4.33	2.00	***0.000***
BASO%	0.45 ± 0.71	0.30	0.44 ± 0.38	0.30	0.548
NEU#	5.72 ± 3.32	5.31	4.81 ± 2.29	4.31	0.058
LYM#	32.89 ± 53.30	18.41	1.79 ± 0.69	1.87	***0.000***
MONO#	2.11 ± 2.89	0.88	0.60 ± 0.25	0.54	***0.000***
EOS#	0.58 ± 2.16	0.18	0.23 ± 0.38	0.16	0.196
BASO#	0.22 ± 0.84	0.08	0.03 ± 0.02	0.03	***0.000***
NRBC#	0.01 ± 0.02	0.00	0.00 ± 0.00	0.00	***0.006***

Abbreviations: WBC, white blood cells; RBC, red blood cells; HGB, hemoglobin; HCT, hematocrit; MCV, mean cell volume; MCH, mean cell hemoglobin; MCHC, mean cell hemoglobin concentration; RDW, red blood cell distribution width; MPV, mean platelet volume; NEU#, absolute neutrophil count; LYM#, absolute lymphocyte count, MONO#, absolute monocyte count; EOS#, absolute eosinophil count; BASO#, absolute basophil count; MPV, mean platelet volume; PDW, platelet distribution width; PCT, plateletcrit; RDW-SD red blood cell distribution width-standart deviation; PLT, trombocyte; NEU%, neutrophıl percentage; LYM%, lymphocyte percentage; MONO%, monocyte percentage; EOS%, eosinophil percentage; BASO%, basophil percentage; NRBC#, absolute nucleated red blood cell; SD: standart deviation.

https://doi.org/10.55549/zbs.1586463

According to Table 3, while HGB, HCT, MCV, MCH, MONO% and MONO# values of males were significantly higher than females in the patient group, PCT value of females was significantly higher than the mean value of males ($p<0.05$). In the control group, the mean WBC, MONO%, EOS%, MONO# and EOS# values of males were significantly higher than females, while the mean PCT value of females was significantly higher than the mean value of males. ($p<0.05$). There was no significant difference between other blood values of males and females in terms of gender in the patient and control groups. ($p>0.05$).

Table 3. Comparison of Blood of the Patient and Control Group in Terms of Gender

	Patient			**Control**		
	Female Mean ± SD	**Male Mean ± SD**	**p**	**Female Mean ± SD**	**Male Mean ± SD**	**p**
WBC	25.04 ±14.65	52.72 ± 72.77	0.109	6.79 ± 2.84	7.89 ± 2.35	***0.036***
RBC	4.71 ± 0.29	4.87 ± 0.77	0.058	4.16 ± 0.52	4.41 ± 0.78	0.089
HGB	12.99 ± 1.30	14.11 ± 2.11	***0.019***	12.36 ± 1.43	12.95 ± 2.21	0.160
HCT	40.29 ± 3.32	43.52 ± 5.37	***0.008***	36.85 ± 4.04	37.30 ± 9.02	0.230
MCV	85.50 ± 5.19	90.18 ± 7.98	***0.029***	88.97 ± 6.24	87.86 ± 5.96	0.694
MCH	27.31 ± 3.01	29.26 ± 2.69	***0.026***	29.76 ± 2.23	29.49 ± 2.39	0.836
MCHC	32.24 ± 1.48	31.19 ± 6.15	0.969	33.53 ± 1.33	33.67 ± 1.38	0.575
RDW	14.47 ± 1.65	14.28 ± 1.80	0.929	14.80 ± 1.72	14.64 ± 2.27	0.200
RDW-SD	44.18 ± 2.51	45.97 ± 8.96	0.132	47.81 ± 5.59	46.18 ± 7.03	0.230
PDW	12.57 ± 2.36	12.79 ± 2.78	0.852	12.60 ± 2.36	11.86 ± 2.01	0.154
PLT	252.52 ± 71.46	214.87 ± 95.72	0.085	275.86 ± 66.55	246.52 ± 81.70	0.128
MPV	10.38 ± 1.09	10.03 ± 1.48	0.616	10.74 ± 0.90	10.34 ± 0.90	0.070
PCT	0.26 ± 0.07	0.21 ± 0.10	***0.037***	0.30 ± 0.08	0.26 ± 0.07	***0.031***
NEU%	25.58 ± 12.43	21.25 ± 15.69	0.146	63.93 ± 9.71	62.74 ± 10.49	0.768
LYM%	68.13 ± 15.15	70.78 ± 18.26	0.398	26.33 ± 9.36	24.20 ± 9.08	0.258
MONO%	1.20 ± 1.86	2,76 ± 3.33	***0.003***	0.51 ± 0.21	0.66 ± 0.26	***0.016***
EOS%	1.50 ± 3.62	0.87 ± 0.82	0.976	1.69 ± 1.56	4.04 ± 5.36	***0.016***
BASO%	0.38 ± 0.22	0.50 ± 0.92	0.575	0.51 ± 0.50	0.39 ± 0.26	0.819
NEU#	5.21 ± 1.40	6.08 ± 4.19	0.673	4.48 ± 2.47	5.05 ± 2.17	0.166
LYM#	18.21 ± 13.18	43.52 ± 67.59	0.234	1.72 ± 0.74	1.84 ± 0.66	0.510
MONO#	1.20 ± 1.86	2.76 ± 3.33	***0.003***	0.51 ± 0.21	0.66 ± 0.26	***0.016***
EOS#	1.05 ± 3.32	0.24 ± 0.15	0.130	0.11 ± 0.13	0.32 ± 0.46	***0.002***
BASO#	0.08 ± 0.05	0.32 ± 1.09	0.057	0.03 ± 0.02	0.03 ± 0.02	0.936
NRBC#	0.00 ± 0.01	0.01 ± 0.03	0.657	0.00 ± 0.00	0.00 ± 0.00	0.210

Abbreviations: WBC, white blood cells; RBC, red blood cells; HGB, hemoglobin; HCT, hematocrit; MCV, mean cell volume; MCH, mean cell hemoglobin; MCHC, mean cell hemoglobin concentration; RDW, red blood cell distribution width; MPV, mean platelet volume; NEU#, absolute neutrophil count; LYM#, absolute lymphocyte count, MONO#, absolute monocyte count; EOS#, absolute eosinophil count; BASO#, absolute basophil count; MPV, mean platelet volume; PDW, platelet distribution width; PCT, plateletcrit; RDW-SD red blood cell distribution width-standart deviation; PLT, trombocyte; NEU%, neutrophıl percentage; LYM%, lymphocyte percentage; MONO%, monocyte percentage; EOS%, eosinophil percentage; BASO%, basophil percentage; NRBC#, absolute nucleated red blood cell; SD: standart deviation

Within the scope of our study, a low level of correlation was found between the ages and blood values of the respondents in the patient and control groups. When the correlation between age and blood values of the patient group was analyzed, significant correlations were found only in WBC ($r=0.286$, $p=0.044$), LYM% ($r=0.294$, $p=0.038$), LYM# ($r=0.328$, $p=0.020$), NEU% ($r= -0.291$, $p=0.040$). No significant relationship was found between disease stage, family history of cancer, other present diseases and blood values ($p>0.05$).

https://doi.org/10.55549/zbs.1586463

Discussion

In our study, the hematological parameters of 50 patients diagnosed with CLL and 50 healthy control groups without a history of cancer were compared. WBC, RBC, HGB, HCT, LYM%, MONO%, LYM#, MONO#, BASO#, and NRBC# values were significantly higher in CLL patients relative to the control group, whereas MCH, MCHC, PLT, PCT, NEU%, and EOS% values were significantly higher in the control group.

When compared with the literature, the results obtained reveal the effects on the hematological profile of CLL and its importance for clinical management.

Hayran et al. reported that CLL patients had low HGB, PLT, NEU%, and EOS# values and high WBC, LYM#, NEU#, MONO#, and BASO# values relative to controls (Hayran et al., 2006). Similarly, in our study, WBC, LYM#, MONO# and BASO# values were found to be significantly higher in CLL patients relative to the control group, PLT and NEU% values were found to be significantly lower, and although NEU# was higher than the control group, no significant relationship was found. In contrast to this study, HGB was found to be significantly higher in the patient group and EOS# was found to be higher in the patient group, although no significant relationship was found.

The study by Rafiq et al. shows that WBCs and erythrocyte sedimentation rate (ESR) are higher, while PLT, RBCs, and HGB values are lower in CLL patients relative to the healthy population (Rafiq et al., 2014). Similarly, in our study, WBC values were found to be significantly higher and PLT values were found to be lower in CLL patients relative to the control group. Unlike this study, it was found that HGB and RBC values were significantly higher in the patient group.

Ali et al. reported that HGB, RBCs, PLT, and WBCs values showed a significant decrease in the CLL group relative to the control group (Ali et al., 2017). In our study, it is consistent with the significant decrease in PLT value, however, it was found that HGB, RBC, and WBC significantly increased in CLL patients.

Hendy et al. showed a significant decrease in HGB and PLT values in CLL patients relative to the control group, while ESR, WBC, and lymphocyte count were found to be significantly increased in CLL patients (Hendy et al., 2016). In our study, this is consistent with the changes observed in PLT, WBC and lymphocyte counts in the literature. However, HGB level was found to be significantly higher in CLL patients.

Namazi et al. reported that WBC, monocyte, and lymphocyte values were significantly higher and PLT values were lower in CLL patients. Although RBC values were higher in the control group, there was no significant relationship (Namazi et al., 2019). In our study, it was found that WBC, RBC, monocyte, and lymphocyte values were significantly higher in CLL patients than in the control group, while PLT values were significantly lower. Except for the RBC value, these results show that our study is compatible with the literature.

Mahmoud et al. found that WBC, LYM (%), LYM#, NEU#, MONO# values were significantly higher, and MONO (%), NEU (%), HGB and PLT values were significantly lower in the patient group relative to the control group, and they also reported that although the MPV value was lower in the patient group, there was no significant difference (Mahmoud et al., 2024). Although our study was generally similar to the results of this study, MONO(%) and HGB values were found to be significantly higher in the patient group unlike this study. Additionally NEU# value was found to be higher in the patient group as in this study, but no significant relationship was found.

https://doi.org/10.55549/zbs.1586463

Özbalcı et al. reported that WBC values were significantly higher in the patient group relative to controls and PCT and PLT values were significantly lower (Ozbalci et al., 2023). Our study is consistent with the data of this study. In our study, WBC values were significantly higher and PLT and PCT values were significantly lower in the patient group relative to the control group.

Conclusion

These findings suggest that the CBC parameters of CLL patients show significant differences relative to healthy controls and these differences may be important in the diagnosis and follow-up processes. Our study gives generally consistent results with the existing studies in the literature, but also shows that there are differences in some values, which emphasises the need for careful monitoring of CBC parameters in CLL patients. In addition, changes in these parameters may be important in the evaluation of the prognosis and treatment response of CLL.

Acknowledgment:

We thank Prof. Dr. Mehmet Yılmaz for his help in collecting samples from SANKO University Hospital for our study.

This study was presented as an oral presentation at the X. Experimental Hematology Congress with International Participation.

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