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Are Chronic lymphocytic leukemia blood parameters differing from Other leukemias subtypes

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Abstract

Background: Adults widely acknowledge CLL as a prevalent lymphoproliferative disease, a hematological malignancy. Thus, the objective of this study was to assess potential differences in blood parameters among CLL and other subtypes of leukemia. **Methodology**: The current study utilized lymphoma data acquired from El-Obeid Oncology Center. The document included data on lymphoma patients diagnosed between January 2018 and January 2020. The sample included a total of one hundred patients, of which sixty-one had CLL and forty-nine did not. The traditional BM aspiration diagnosis for the patient was lymphoma. **Results**: Within this series, CLL was the most prevalent form of cancer, followed by CML, NHL, MM, HL, and various other types, making up 61%, 17%, 11%, 6%, and 3% of cases, respectively. All cases of CLL, MM, and NHL exhibited BM hypercellularity. Megakaryopoiesis was not observed in ten cases, which consisted of eight (80%) CLL patients and two (20%) MM patients. We observed megakaryopoiesis in 43 instances, with 60.5% of the cases being CLL and 30.2% being CML. There were only two instances where CLL showed a decrease in megakaryopoiesis. We found 34 patients with depressed erythropoiesis. This included CLL in 59% of cases, CML in 26.5% of cases, and MM in 8.8% of cases. **Conclusion**: CLL demonstrates a unique set of hematological parameters when compared to other blood malignancies. CML demonstrates a pattern that is similar to CLL in different hematological parameters, such as the overall count of white blood cells.

Keywords: leukemia, lymphoma, blood cancer, hematological parameters, Sudan

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Introduction

Chronic Lymphocytic Leukemia (CLL) is a prevalent type of leukemia in adults, characterized by a wide range of clinical consequences [1]. Although the clinical course of this condition is typically slow, the lack of response to treatment and the advancement of the disease continues to be significant challenges in medical practice [2]. The proliferative growth of deviant monoclonal B lymphocytes distinguishes CLL as a malignant B cell neoplasm. CLL constitutes 25% of all cases of leukemia in Western nations, making it the most prevalent subtype. While a considerable number of patients do not manifest any symptoms, a subset may display characteristic symptoms of lymphoma, acquired immunodeficiency disorders, or autoimmune complications [3]. On a global scale, the prevalence of CLL has been steadily rising. There was a small decrease in the number of deaths and disability-adjusted life years (DALYs). The socio-demographic index (SDI) influences the impact of mortality and DALY. With advancing age, there is a notable increase in the incidence rate, death rate, and DALY rate of CLL. Males and females had different incidence rates across different SDI quintiles. Researchers identified smoking, elevated body mass index, and workplace exposure to benzene or formaldehyde as potential risk factors associated with CLL. Global age-standardized incidence rates (ASIRs) are projected to rise until 2030, whereas ASRs are expected to decline until 2030 [4].

CLL is a form of adult leukemia characterized by the clonal accumulation of lymphocytes. Immunophenotypic changes have proven to be highly valuable in predicting the clinical course, patient survival, and guiding initial treatment decisions [5].

CLL in Sudan is a disease commonly found in older individuals, as described in the literature, with a higher prevalence among males compared to females. Overall, different age and sex groups showed consistent distribution of hematological parameters. A significant number of patients experienced vague symptoms, and a considerable portion of them sought medical attention at advanced stages, which is a common trend in many developing nations [6]. Thus, the current study seeks to evaluate if there are variations in blood parameters between CLL and other subtypes of leukemia.

Materials and Methods

The current study utilized lymphoma data acquired from El-Obeid Oncology Center. The document included data on lymphoma patients diagnosed between January 2018 and January 2020. The sample included a total of one hundred patients, of which sixty-one had CLL and forty-nine did not. We have diagnosed the patient with lymphoma based on traditional BM aspiration. We conducted a reassessment of the diagnosis of the blood samples to confirm the previous diagnosis and categorize the lymphomas into CLL and non-CLL types. We performed further tests, such as flow cytometry and molecular analyses, on a subset of individuals. We also conducted a blood analysis to assess various parameters.

The obtained information sets were entered into a computer program called Statistical Package for Social Sciences (SPSS version 16; SPSS Inc., Chicago, IL). The chi-square test was used, and $P < 0.05$ was considered significant.

Ethical Considerations

The protocol of this study was established in accordance with the 2013 Declaration of Helsinki, and this study was further approved by Human Research Ethical Committee at MRCC: HREC 0006/MRCC.3/24.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 24 was used for the statistical analyses. Descriptive data reported as frequencies and percentages were included in the statistical analysis.

Results

This study investigated 100 patients aged 15 to 117 years, with a mean age of 61. Of the 100 patients, 57 were men and 43 were women. For this group of people, CLL was the most common type of cancer. It was followed by Chronic Myeloid Leukemia (CML), Non-Hodgkin's lymphoma (NHL), Multiple Myeloma (MM), Hodgkin's lymphoma (HL), and other types, which made up 61%, 17%, 11%, 6%, and 3%, respectively.

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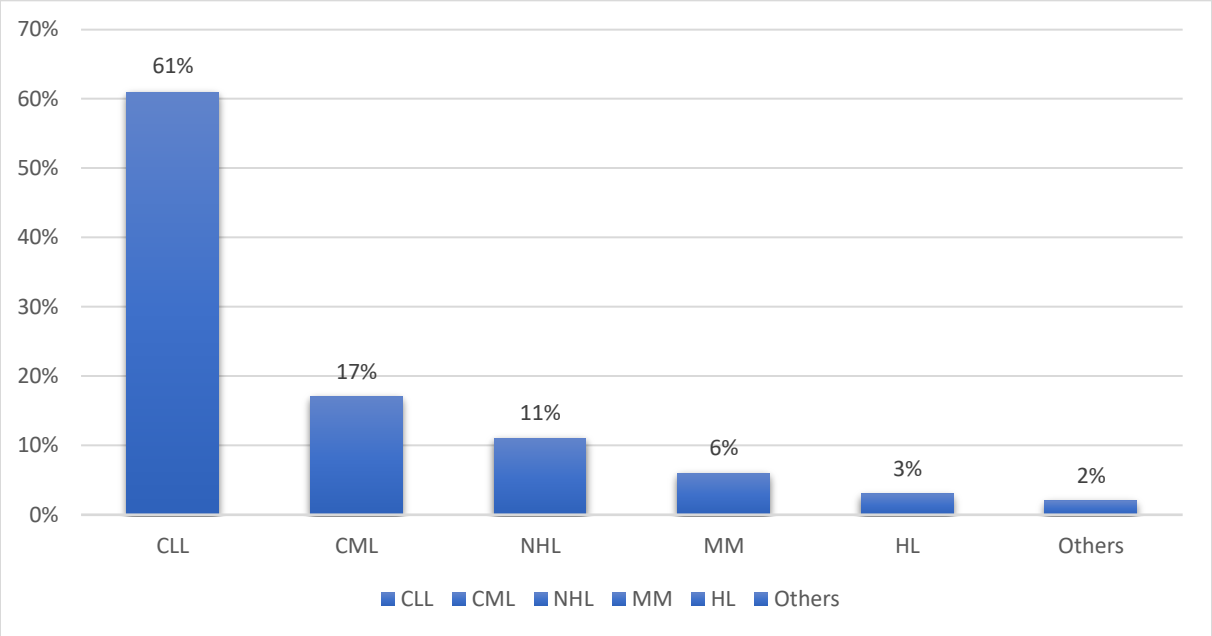

Figure 1. Proportions of leukemia subtypes.

Table 1 describes the distribution of leukemia types based on bone marrow (BM) cellular alterations. All cases of CLL, MM, and NHL showed BM hypercellularity. Megakaryopoiesis was not found in ten cases, including eight (80%) CLL patients and two (20%) MM patients. Megakaryopoiesis was observed in 43 cases, including 26/43 (60.5%) CLL cases and 13/43 (30.2%) CML cases. Only two cases of CLL had depressed megakaryopoiesis. 34 patients, including 20/34 (59%) CLL, 9/34 (26.5%) CML, and 3/34 (8.8%) MM, had depressed erythropoiesis.
We found depressed granulopoiesis in 9 patients, 7 of whom (77.8%) had CLL. We detected myeloid cells in 16 individuals, of which 14 (87.5%) had CML.

Table 1. Distribution of leukemia types according to bone marrow (BM) cellular changes

Variable	CLL	HL	NHL	MM	CML	Other	Total
BM Cellurality							
Hyper	40	1	3	4	16	1	65
Normal	0	0	0	1	0	0	1
Total	40	1	3	5	16	1	66
***M*egakaryopoiesis**							
Not seen	8	0	0	2	0	0	10
Seen	26	0	2	1	13	1	43
Normal	2	0	0	0	1	0	3
Active	2	1	1	1	2	0	7
Depressed	2	0	0	0	0	0	2
Total	40	1	3	4	16	1	65
Erythropoiesis							
Normal	19	0	1	1	7	0	28
Depressed	20	0	1	3	9	1	34
Active	1	1	1	0	0	0	3
Total	40	1	3	4	16	1	65
Granulopoiesis							
Normal	30	0	2	1	1	0	34

Depressed	7	0	0	1	0	1	9
Active	0	1	0	1	1	0	3
Myeloid cells	1	0	1	0	14	0	16
Plasma cell	0	0	0	2	0	0	2
Total	38	1	3	5	16	1	64

Table 2 and Figure 2 summarized the distribution of leukemia types as hematological parameters changed. CLL cases had the lowest Hb concentration, followed by CML and NHL at 46/80 (57.5%), 17/80 (21.3%), and 11/80 (13.8%), respectively.

We found low MCHC in 16 patients, of which 10 (62.5%) had CLL and 3 (18.8%) had CML. CLLs were the only two patients with a high MCHC. CLL, CML, and NHL showed the lowest MCH, with 15/33 (45.5%), 7/33 (21.2%), and 5/33 (15.2%), respectively.

CLL had the lowest hematocrit, followed by CML and NHL, with values of 30/60 (50%), 17/60 (28.3%), and 7/60 (11.7%), respectively. 48 patients, including 23/48 (48%) with CLL and 14/48 (29%) with CML, had low TRBCs. 31 patients, 26 of whom (83.9%) had CLL, had low platelet counts. On the other hand, elevated platelet counts were detected in ten individuals, seven of whom (70%) had CML. However, when the percentages of all leukemia subtypes were calculated, significant variations were discovered.

Table 2. Distribution of the leukemia types by hematological parameter changes

Variable	CLL	HL	NHL	MM	CML	Other	Total
Hb-Concentration							
Low	46	1	11	5	17	0	80
Normal	7	2	0	0	0	1	10
High	1	0	0	0	0	0	1
Total	54	3	11	5	17	1	91
Mean corpuscular hemoglobin concentration (MCHC)							
Low	10	0	2	1	3		16
Normal	27	3	7	4	10		51
High	2	0	0	0	4		6
Total	39	3	9	5	17		73
Mean corpuscular hemoglobin (MCH)							
Low	15	3	5	3	7		33
Normal	22	0	4	1	6		33
High	3	0	0	1	4		8
Total	40	3	9	5	17		74
Hematocrit							
Low	30	1	7	5	17		60
Normal	10	2	2	0	0		14
Total	40	3	9	5	17		74
Total Red blood cells count (TRBCs)							
Low	23	1	7	3	14		48
Normal	16	2	3	2	2		25
High	1	0	0	0	0		1
Total	40	3	10	5	16		74
Total Platelets count							
Low	26	0	3	2	0	0	31
Normal	26	2	7	2	10	1	48
High	0	1	1	1	7	0	10
Total	52	3	11	5	17	1	89

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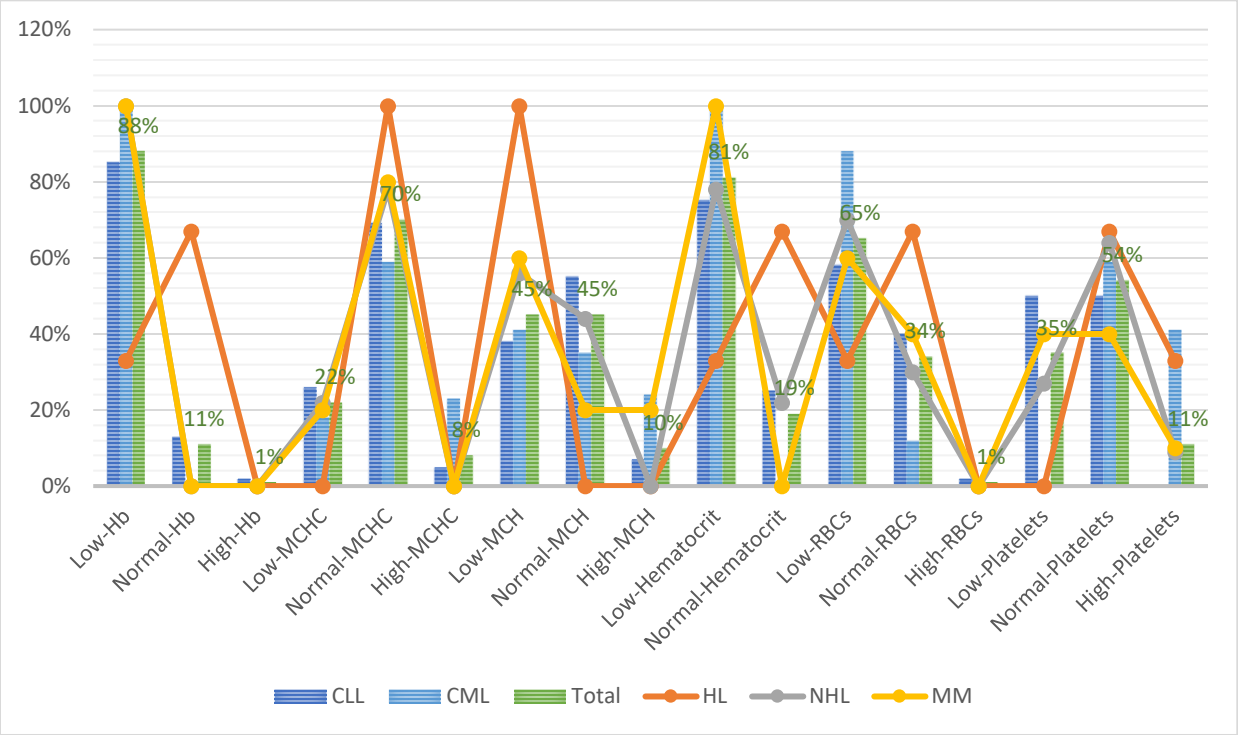

Figure 2. Description of the proportions of the hematological parameters within the entire leukemia type.

Table 3 and Figure 3 describe the changes in the distribution of leukemia types based on white blood cells. A high WBC count was found in 74 patients, 53 (71.6%) of whom had CLL and 17 (23%) had CML. There were only four cases with low total WBC counts, three of which (75%) were MM.

63 patients, 51 (81%) with CLL and 8 (12.7%) with NHL, had a high lymphocyte count. There were 15 cases of low lymphocyte count, of which 13 (86.7%) were CML.

The lowest neutrophil cell count was recorded in CLL, followed by NHL, with 37/50 (74%) and 8/50 (16%), respectively. We detected only four cases of CML with a high neutrophil level. Of the nine cases with low monocyte cell counts, seven (77.8%) were CLL. High monocyte counts were found in five patients, three of whom (60%) had CLL.

Table 3. Distribution of the leukemia types by white blood cell changes

Variable	CLL	HL	NHL	MM	CML	Other	Total
Total white blood cells count (WBCs)							
Low	0	1	0	3	0	0	4
Normal	2	1	8	2	0	1	14
High	53	1	3	0	17	0	74
Total	55	3	11	5	17	1	92
Lymphocyte cells count							
Low	1	0	0	1	13		15
Normal	1	0	2	3	4		10
High	51	3	8	1	0		63

Total	53	3	10	5	17		88
Neutrophil cells Count							
Low	37	3	8	2	0		50
Normal	5	0	1	3	13		22
High	0	0	0	0	4		4
Total	42	3	9	5	17		76
Monocyte Cells Count							
Low	7	0	0	0	2		9
Normal	29	2	7	3	12		53
High	3	0	0	1	1		5
Total	39	2	7	4	15		67

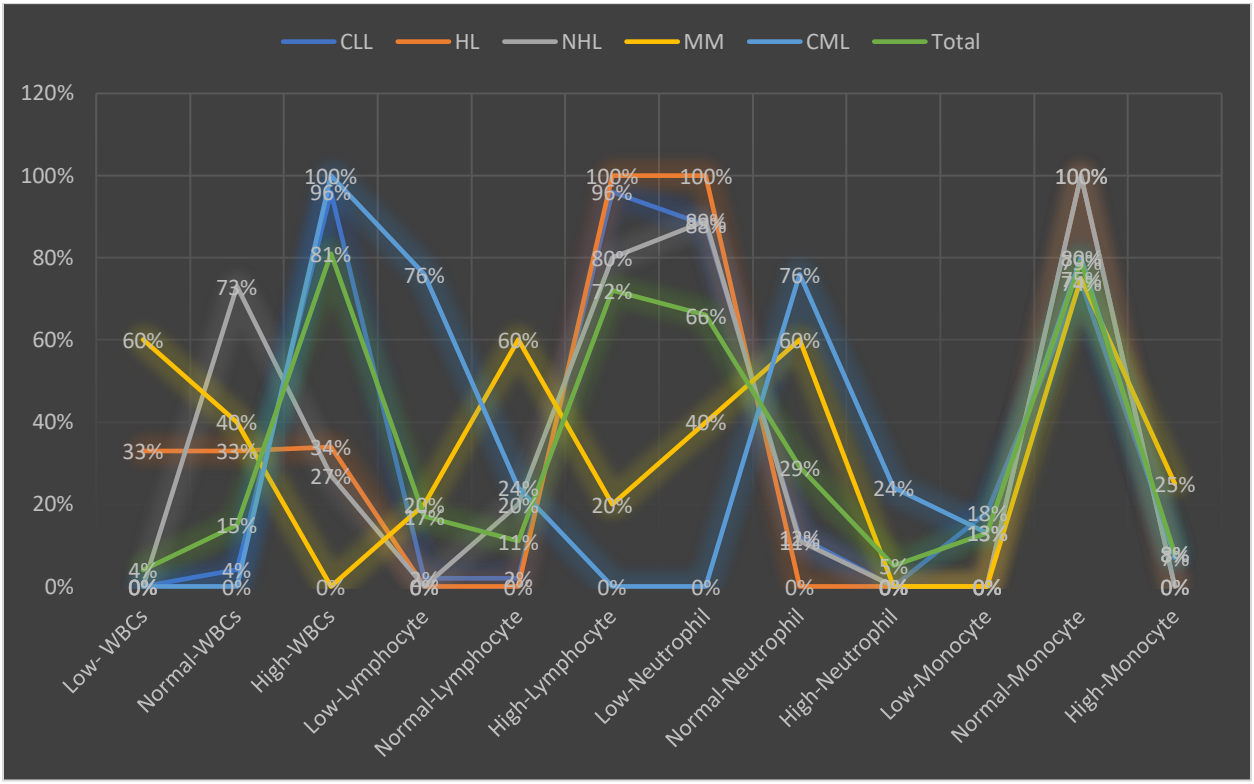

Figure 3. Description of the proportions of the white blood cells changes within entire leukemia type.

DISCUSSION

The investigation of hematological parameters in various types of leukemia can provide insights into distinct cancer types and serve as a predictor for CLL progression behaviors. Consequentially, this study aimed to conduct a comparative analysis of the hematological characteristics of CLL with other kinds of leukemia. The results of the present investigation indicate that males are more commonly afflicted with leukemias than females. Men tend to have higher rates of incidence and mortality than women, according to previous reports. This emphasizes the importance of considering biological and epidemiological factors in understanding the impact of the disease [7, 8]. Previous studies have revealed considerable inequalities between sexes in a variety of domains, including awareness, treatment, healthcare utilization, disease control rate, time to diagnosis, occupational exposure, and overall survival rates [9, 10].

The current investigation found a substantial increase in BM hypercellularity in all cases of CLL, MM, and NHL. Enhancing stimulation to generate more of a single cell line can lead to an increase in the production of other cell lines, resulting in an overall increase in bone marrow cellularity. Bone marrow cellularity changes can influence individual cell lines or the cells as a whole [11].

This study observed megakaryopoiesis in 60.5% of CLL cases and 30.2% of CML cases. We found that two CLL patients reported cases of depressed megakaryopoiesis. There was a discovery of decreased erythropoiesis in 59% of CLL cases, 26.5% of CML cases, and 8.8% of MM cases. Out of the nine patients, a significant majority (77.8%) displayed depressed granulopoiesis. Interestingly, seven of these patients also happened to have CLL. Observations revealed that 14 of the 16 individuals with myeloid cells, accounting for 87.5%, received a diagnosis of CML. Recent research highlights the bone marrow niche as a crucial factor in the development of hematopoietic stem cells, revealing intriguing and intricate environmental influences. Megakaryocytes adhere to the complex bone marrow microenvironment, which includes interactions between cells, contact with the extracellular matrix, and blood circulation within the sinusoidal lumen. Mutations in both germinal and acquired hematopoietic stem cells can alter the maturation, proliferation, and platelet output of megakaryocytes. Disrupted megakaryopoiesis can also impact the hematopoietic niche, highlighting the significant role of megakaryocytes in maintaining bone marrow balance [12].

This study found a strong link between two types of leukemia—chronic lymphocytic leukemia (CLL) and chronic myeloid leukemia (CML)—and red blood cells (RBCs), mean corpuscular hemoglobin concentration (MCHC), and mean corpuscular hemoglobin (MCH).
Velez et al.'s 2014 study revealed that people with CLL are more likely than the general population to develop a second malignancy, specifically skin cancer [13]. CLL is also associated with a greater incidence of second hematological malignancies, as demonstrated by Hatoum et al. in 2007 [14]. Usually, this process involves transforming a disease into a more potent variant of non-Hodgkin lymphoma, multiple myeloma, or prolymphocytic lymphoma. CLL patients have a relatively low chance of developing AML. In addition, individuals with myeloproliferative disorders are more likely to develop lymphoid malignancies [15]. These findings suggest that myeloid malignancies can transform into lymphoid malignancies and vice versa. Giri et al. reported the common detection of AML after CLL treatment in 2015 [16].

71.6% of patients with CLL had a significant increase in white blood cell count (WBC elevation > 100 x 10(9)/L), while 23% of patients had CML. While the impact of an increased WBC count on survival is evident during the initial diagnosis of CLL, its significance in the later stages of the disease is still uncertain [17].

The current study observed a high lymphocyte count in CLL and a low lymphocyte count in CML. Diagnosed CLL requires a peripheral blood absolute lymphocyte count (ALC) of 5 x 10(9)/l or higher. Consistent relative lymphocytosis of > or = 50% of the differential leukocyte count in older adults (50+) suggests CLL inquiry by immunophenotyping peripheral blood lymphocytes and bone marrow [18]. CML is considered to be one of the best-known types of myeloproliferative neoplasms. It usually presents with an increase in white blood cell count, but only rarely with an isolated increase in platelet count or lymphocytes [19].

Hematopoietic stem cells (HSCs) play a crucial role in the production of all blood cells through their remarkable proliferative abilities. The durability and impressive capacity for self-renewal of HSCs nevertheless render them prone to the accumulation of mutations. Acquired mutations commonly cause preleukemic clonal hematopoiesis in older individuals. While often showing no symptoms, the preleukemic state increases the vulnerability to blood malignancies. However, while preleukemic HSCs play a widely recognized role in adult myeloid leukemia (AML), their influence on other hematopoietic malignancies has received less extensive research [20]. According to Filipek-Gorzała et al. (2024), the number of studies looking into pre-clinical chronic myeloid leukemia (CML) has grown significantly. This is a condition that happens before the chronic phase (CP) and doesn't have leukocytosis or other blood/marrow features of CML CP [21]. This variation may explain the different results observed in the current investigation's blood parameter counts.

Although the present study presents important updates about leukemia from Sudan, it has some limitations, including the outnumber of CLL compared to other types of leukemia in this study. This reduces the comparability level.

In conclusion, CLL exhibits a distinct pattern of hematological parameters in comparison to other blood malignancies. CML exhibits a pattern that's comparable to CLL in various hematological parameters, including the total count of white blood cells. Additional research in this context is considered crucial for revealing the precise connection between CLL and other blood malignancies, which highlights the alterations in the peripheral blood image.

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Data Availability:
The data presented in this study are available on request to the corresponding author.

Disclosure of Interest
No interest to declare

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