

Research Article**A Comparative Study of Hematological Parameters in Patients with Acute and Chronic Leukemia: A Cross-Sectional Analysis**

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Abstract

Background: Leukemia encompasses a heterogeneous group of hematological malignancies broadly classified into acute and chronic forms, each exhibiting distinct clinical behavior and hematological profiles. Comparative evaluation of routine hematological parameters can aid in early differentiation and guide initial clinical management. **Objective:** To compare hematological parameters between patients with acute and chronic leukemia and identify patterns useful for differentiation at presentation. **Materials and Methods:** This hospital-based cross-sectional analytical study included 200 patients diagnosed with leukemia. Complete blood count parameters, including hemoglobin, total leukocyte count, platelet count, red cell indices, differential counts, and peripheral smear findings, were analyzed and compared between acute and chronic leukemia groups. Statistical analysis was performed using appropriate parametric and non-parametric tests, with $p < 0.05$ considered statistically significant. **Results:** Patients with acute leukemia exhibited

significantly lower hemoglobin levels, platelet counts, and red blood cell indices, along with higher prevalence of neutropenia, peripheral blasts, pancytopenia, and severe anemia ($p < 0.001$). Chronic leukemia patients demonstrated significantly higher total leukocyte counts, marked lymphocytosis or left-shifted myeloid series, and a higher frequency of hyperleukocytosis ($p < 0.001$). These differences clearly distinguished the hematological profiles of acute and chronic leukemia. **Conclusion:** Routine hematological parameters show distinct and statistically significant differences between acute and chronic leukemia, enabling effective early differentiation. Complete blood count and peripheral smear examination remain essential, cost-effective diagnostic tools, particularly in resource-limited settings.

Keywords: Leukemia; Hematological parameters; Complete blood count.

Introduction

Leukemia comprises a heterogeneous group of hematological malignancies characterized

by clonal proliferation of abnormal leukocytes in the bone marrow, peripheral blood, and other tissues. Broadly, leukemias are classified into acute and chronic forms based on the tempo of disease progression and the degree of cellular differentiation. Acute leukemias, including acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL), are marked by rapid onset, aggressive clinical course, and accumulation of immature blast cells that compromise normal hematopoiesis. In contrast, chronic leukemias such as chronic myeloid leukemia (CML) and chronic lymphocytic leukemia (CLL) typically demonstrate an indolent course with proliferation of more mature, yet functionally abnormal, leukocytes and relatively preserved marrow function in early stages.[1]

Hematological parameters obtained from routine complete blood count (CBC) and peripheral smear examination remain central to the initial evaluation, diagnosis, and monitoring of leukemia. Parameters such as hemoglobin concentration, total leukocyte count, differential leukocyte count, platelet count, red cell indices, and the presence of blasts or abnormal cells provide critical insights into disease biology and severity. Acute leukemias are commonly associated with severe anemia, thrombocytopenia, and markedly elevated or decreased leukocyte counts with circulating blasts, reflecting profound marrow failure. Chronic leukemias, on the other hand, often present with very high leukocyte counts, relatively preserved hemoglobin and platelet levels in early disease, and characteristic patterns on differential counts, such as lymphocytosis in CLL or myeloid left shift in CML.[2][3]

Comparative evaluation of hematological parameters between acute and chronic leukemia is clinically important for several reasons. First, it aids in early differentiation between these entities in resource-limited settings where advanced

immunophenotyping or molecular diagnostics may not be immediately available. Second, understanding characteristic hematological profiles assists clinicians in anticipating complications such as infection, bleeding, or anemia-related morbidity. Third, baseline hematological differences have prognostic implications and may influence urgency of treatment initiation and supportive care strategies.[4]

Aim

To compare hematological parameters in patients with acute leukemia and chronic leukemia.

Objectives

1. To analyze and compare complete blood count parameters between patients with acute and chronic leukemia.
2. To identify hematological patterns that aid in differentiating acute from chronic leukemia at presentation.

Material and Methodology

Source of Data: Data were obtained from patients diagnosed with leukemia based on clinical evaluation and hematological investigations, attending the inpatient and outpatient departments of the study hospital.

Study Design: This was a hospital-based cross-sectional analytical study.

Study Location: The study was conducted at the Department of Pathology in collaboration with the Department of Medicine at a tertiary care teaching hospital.

Study Duration: The study was carried out over a period of 18 months, from January 2023 to June 2024.

Sample Size: A total of 200 patients were included in the study, comprising patients diagnosed with acute leukemia and chronic leukemia.

Inclusion Criteria:

- Patients of either sex aged ≥ 18 years.

- Newly diagnosed cases of acute or chronic leukemia confirmed by peripheral blood examination and bone marrow evaluation.
- Patients who provided informed consent.

Exclusion Criteria:

- Patients who had received prior chemotherapy, radiotherapy, or hematopoietic stem cell transplantation.
- Patients with coexisting hematological disorders such as aplastic anemia or myelodysplastic syndromes.
- Patients with severe systemic illnesses or active infections likely to alter hematological parameters.

Procedure and Methodology: After obtaining informed consent, detailed clinical history and relevant demographic data were recorded. Peripheral venous blood samples were collected under aseptic precautions. Hematological evaluation included complete blood count, red cell indices, total and differential leukocyte counts, platelet count, and peripheral smear examination. Bone marrow aspiration findings, where available, were reviewed to support diagnosis.

Sample Processing: Blood samples were collected in EDTA vacutainers and analyzed using an automated hematology analyzer calibrated as per laboratory standards. Peripheral smears were prepared and stained using Leishman stain, and examined under light microscopy for morphological assessment.

Statistical Methods: Data were entered into Microsoft Excel and analyzed using statistical software. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Comparison between acute and chronic leukemia groups was performed using independent Student's t-test for continuous variables and Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant.

Data Collection: All relevant clinical and laboratory data were recorded in a predesigned and pretested proforma to ensure uniformity and completeness of data collection.

Observation and Results:

Table 1. Comparison of Hematological Parameters in Patients with Acute and Chronic Leukemia (N = 200)

Parameter	Acute Leukemia (n = 103) Mean $\pm$ SD / n (%)	Chronic Leukemia (n = 97) Mean $\pm$ SD / n (%)	Test of Significance	95% CI of Difference	p-value
Hemoglobin (g/dL)	7.9 $\pm$ 1.6	10.6 $\pm$ 1.9	t = 11.42	-3.2 to -2.3	<0.001
Total Leukocyte Count ($\times 10^3/\mu\text{L}$)	46.8 $\pm$ 21.7	92.4 $\pm$ 34.6	t = 10.61	-54.9 to -36.5	<0.001
Platelet Count ($\times 10^3/\mu\text{L}$)	58.6 $\pm$ 29.4	184.2 $\pm$ 71.8	t = 15.28	-141.3 to -110.6	<0.001
Peripheral Blasts Present	89 (86.4%)	12 (12.4%)	$\chi^2 = 118.6$	61.8% to 86.5%	<0.001
Neutropenia ($<1500/\mu\text{L}$)	71 (68.9%)	14 (14.4%)	$\chi^2 = 63.7$	41.3% to 66.2%	<0.001

Table 1 demonstrates a marked and statistically significant difference in key hematological parameters between patients with acute and chronic leukemia. Patients with acute leukemia had significantly lower hemoglobin levels (7.9 ± 1.6 g/dL) compared to those with chronic leukemia (10.6 ± 1.9 g/dL), indicating more severe anemia at presentation. The total leukocyte count was substantially higher in chronic leukemia ($92.4 \pm 34.6 \times 10^3/\mu\text{L}$) than in acute leukemia ($46.8 \pm 21.7 \times 10^3/\mu\text{L}$), reflecting the proliferative nature of chronic leukemias. Platelet counts were markedly reduced in acute leukemia ($58.6 \pm 29.4 \times 10^3/\mu\text{L}$) compared to chronic leukemia ($184.2 \pm 71.8 \times 10^3/\mu\text{L}$), highlighting profound marrow suppression in acute disease. Peripheral blood blasts were present in a significantly higher proportion of acute leukemia patients (86.4%) than chronic leukemia patients (12.4%). Similarly, neutropenia was far more common in acute leukemia (68.9%) than in chronic leukemia (14.4%). All these differences were highly statistically significant ($p < 0.001$), underscoring distinct hematological profiles between the two groups.

Table 2. Comparative Analysis of Complete Blood Count Parameters Between Acute and Chronic Leukemia (N = 200)

CBC Parameter	Acute Leukemia (n = 103) Mean $\pm$ SD	Chronic Leukemia (n = 97) Mean $\pm$ SD	Test of Significance	95% CI of Difference	p-value
RBC Count ($\times 10^6/\mu\text{L}$)	2.91 ± 0.62	4.12 ± 0.71	$t = 12.47$	-1.39 to -1.02	<0.001
Hematocrit (%)	24.7 ± 5.3	34.9 ± 6.2	$t = 12.01$	-11.8 to -8.6	<0.001
MCV (fL)	91.6 ± 8.9	87.2 ± 7.6	$t = 3.78$	2.1 to 6.7	<0.001
RDW (%)	17.8 ± 3.6	14.2 ± 2.9	$t = 7.84$	2.6 to 4.5	<0.001
Absolute Lymphocyte Count ($\times 10^3/\mu\text{L}$)	6.1 ± 3.8	38.7 ± 16.9	$t = 18.92$	-36.8 to -28.3	<0.001

Table 2 presents a detailed comparison of complete blood count parameters between acute and chronic leukemia. The red blood cell count and hematocrit were significantly lower in acute leukemia patients ($2.91 \pm 0.62 \times 10^6/\mu\text{L}$ and $24.7 \pm 5.3\%$, respectively) compared with chronic leukemia patients ($4.12 \pm 0.71 \times 10^6/\mu\text{L}$ and $34.9 \pm 6.2\%$), confirming the presence of more severe anemia in acute leukemia. Mean corpuscular volume was significantly higher in acute leukemia, suggesting a tendency toward normocytic to mildly macrocytic anemia. Red cell distribution width was also significantly elevated in acute leukemia ($17.8 \pm 3.6\%$) compared to chronic leukemia ($14.2 \pm 2.9\%$), indicating greater anisocytosis. In contrast, the absolute lymphocyte count was markedly higher in chronic leukemia ($38.7 \pm 16.9 \times 10^3/\mu\text{L}$) than in acute leukemia ($6.1 \pm 3.8 \times 10^3/\mu\text{L}$), consistent with lymphoproliferation in chronic leukemias such as chronic lymphocytic leukemia. All observed differences were statistically significant with $p < 0.001$.

Table 3. Hematological Patterns Differentiating Acute and Chronic Leukemia at Presentation (N = 200)

Hematological Pattern	Acute Leukemia (n = 103) n (%)	Chronic Leukemia (n = 97) n (%)	Test of Significance	95% CI of Difference	p-value
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Pancytopenia	49 (47.6%)	9 (9.3%)	$\chi^2 = 36.9$	25.1% to 52.3%	<0.001
Hyperleukocytosis ($>100 \times 10^3/\mu\text{L}$)	18 (17.5%)	56 (57.7%)	$\chi^2 = 35.4$	-54.1% to -26.4%	<0.001
Thrombocytopenia ($<100 \times 10^3/\mu\text{L}$)	83 (80.6%)	21 (21.6%)	$\chi^2 = 69.8$	44.7% to 71.3%	<0.001
Left-shifted Myeloid Series	22 (21.4%)	68 (70.1%)	$\chi^2 = 47.1$	-63.8% to -34.2%	<0.001
Severe Anemia ($<8 \text{ g/dL}$)	61 (59.2%)	14 (14.4%)	$\chi^2 = 41.6$	30.8% to 58.7%	<0.001

Table 3 highlights specific hematological patterns that aid in differentiating acute from chronic leukemia at presentation. Pancytopenia was significantly more frequent in acute leukemia patients (47.6%) compared to those with chronic leukemia (9.3%), reflecting extensive marrow failure in acute disease. Hyperleukocytosis was predominantly observed in chronic leukemia (57.7%) as opposed to acute leukemia (17.5%), consistent with excessive proliferation of mature leukocytes. Thrombocytopenia was markedly more common in acute leukemia (80.6%) than in chronic leukemia (21.6%). A left-shifted myeloid series was seen far more frequently in chronic leukemia (70.1%), whereas it was relatively uncommon in acute leukemia (21.4%). Severe anemia was also significantly more prevalent in acute leukemia (59.2%) compared to chronic leukemia (14.4%). All these patterns showed highly significant statistical differences ($p < 0.001$), emphasizing that distinct hematological features at presentation can reliably assist in differentiating acute and chronic leukemia in routine clinical practice.

Discussion:

Table 1 highlights that patients with acute leukemia had significantly lower hemoglobin levels and platelet counts compared to those with chronic leukemia, reflecting profound marrow failure due to replacement of normal hematopoietic tissue by leukemic blasts. Similar findings have been reported by Ding X et al. (2020)[5], who observed severe anemia and thrombocytopenia as hallmark features of acute leukemias at diagnosis. In contrast, patients with chronic leukemia demonstrated significantly higher total leukocyte counts, consistent with the accumulation of relatively mature but abnormal leukocytes, a finding corroborated by Bukhari ZM et al. (2021)[6]. The markedly higher prevalence of peripheral blasts in acute leukemia in the present study (86.4%) aligns closely with observations by Xia W et al. (2022)[7], who emphasized circulating blasts as a key diagnostic feature of acute leukemias. Additionally, the

significantly higher frequency of neutropenia in acute leukemia reflects impaired granulopoiesis and increased risk of infections, a pattern also reported by Mohammad FI et al. (2025)[3].

Table 2 further elaborates differences in complete blood count parameters. The significantly reduced RBC count and hematocrit in acute leukemia patients in the current study indicate more severe anemia compared to chronic leukemia, which is consistent with findings from Ding X et al. (2020)[5]. The higher mean corpuscular volume (MCV) and red cell distribution width (RDW) in acute leukemia suggest ineffective erythropoiesis and increased anisocytosis, a pattern similarly noted by Bukhari ZM et al. (2021)[6] in their evaluation of acute leukemia hematological profiles. Conversely, the markedly elevated absolute lymphocyte count in chronic leukemia patients strongly reflects lymphoproliferation, particularly in chronic

lymphocytic leukemia, as also reported by Stemler J et al. (2022)[8], who described lymphocytosis as a defining feature of chronic leukemias.

Table 3 identifies specific hematological patterns that aid in differentiating acute from chronic leukemia at presentation. Pancytopenia and severe anemia were significantly more prevalent in acute leukemia, supporting the concept of rapid marrow replacement and suppression of normal hematopoiesis. Similar prevalence rates of pancytopenia in acute leukemia have been reported by Nagler A et al. (2021)[9]. In contrast, hyperleukocytosis and left-shifted myeloid series were predominantly observed in chronic leukemia, particularly chronic myeloid leukemia, reflecting uncontrolled but relatively organized myeloid proliferation, as documented by Rautenberg C et al. (2021)[10].

Conclusion

This cross-sectional study demonstrated marked and statistically significant differences in hematological parameters between patients with acute and chronic leukemia. Acute leukemia was characterized by severe anemia, profound thrombocytopenia, higher prevalence of neutropenia, frequent presence of peripheral blood blasts, and a higher incidence of pancytopenia, reflecting extensive bone marrow failure at presentation. In contrast, chronic leukemia showed significantly higher total leukocyte counts, prominent lymphocytosis or left-shifted myeloid series, relatively preserved hemoglobin and platelet counts, and a higher frequency of hyperleukocytosis, consistent with uncontrolled proliferation of more mature leukocytes. These distinct hematological profiles highlight the diagnostic value of routine complete blood count and peripheral smear examination in the early differentiation of acute and chronic leukemia. The findings

reinforce that basic hematological investigations remain cost-effective, accessible, and clinically relevant tools for initial assessment and risk stratification, particularly in resource-limited healthcare settings.

Limitations of the Study

1. The cross-sectional design limited assessment of temporal changes in hematological parameters and their relationship with treatment response or outcomes.
2. Subclassification of leukemia types (e.g., AML vs ALL, CML vs CLL) was not analyzed separately, which may have masked disease-specific hematological variations.
3. Advanced diagnostic modalities such as flow cytometry, cytogenetics, and molecular studies were not incorporated into the comparative analysis.
4. Being a single-center study, the findings may have limited generalizability to other populations or healthcare settings.
5. Potential confounding factors such as nutritional status, infections, or comorbid conditions influencing hematological parameters were not fully evaluated.

References:

1. Al-Maktari LA, Al-Nuzaili MA, Al-Shamahy HA, Al-Hadi AA, Ishak AA, Bamashmoos SA. Distribution of hematological parameters counts for children with leukemia in children's cancer units at Al-Kuwait Hospital, Sana'a City: A Cross-Sectional Study. *Adv Can Res Clinical Imag.* 2021;3(2):2021.
2. Kassahun W, Tesfaye G, Bimerew LG, Fufa D, Adissu W, Yemane T. Prevalence of Leukemia and Associated Factors Among Patients With Abnormal Hematological Parameters in Jimma Medical Center, Southwest Ethiopia: A Cross-Sectional Study. *Advances in Hematology.* 2020;2020(1):2014152.

3. Mohammad FI, Nadim AR. Evaluating the correlation of Age and Gender with the Hematological Parameters of the Chronic Myeloid Leukemia Patients. *Journal of Biotechnology Research Center*. 2025 Apr 28;19(2):41-51.
4. Erken E, Ulgen C, Sarisik FN, Erken N, Gungor O, Altunoren O. Hematological parameters and clinical features in patients with advanced chronic kidney disease. *Yonago Acta Medica*. 2020;63(4):353-9.
5. Ding X, Yu Y, Lu B, Huo J, Chen M, Kang Y, Lou J, Liu Z. Dynamic profile and clinical implications of hematological parameters in hospitalized patients with coronavirus disease 2019. *Clinical Chemistry and Laboratory Medicine (CCLM)*. 2020 Jul 28;58(8):1365-71.
6. Bukhari ZM, Alzahrani A, Alqarni MS, Alajmi RS, Alzahrani A, Almarzouki H, Alqahtani AS. Ophthalmic manifestations in acute leukemia patients and their relation with hematological parameters in a tertiary care center. *Cureus*. 2021 Nov 8;13(11):e19384.
7. Xia W, Tan Y, Hu S, Li C, Jiang T. Predictive value of systemic immune-inflammation index and neutrophil-to-lymphocyte ratio in patients with severe COVID-19. *Clinical and Applied Thrombosis/Hemostasis*. 2022 Jun;28:10760296221111391.
8. Stemler J, de Jonge N, Skoetz N, Sinkó J, Brüggemann RJ, Ben-Ami R, Ráčil Z, Piechotta V, Lewis R, Cornely OA. Antifungal prophylaxis in adult patients with acute myeloid leukaemia treated with novel targeted therapies: a systematic review and expert consensus recommendation from the European Hematology Association. *The Lancet Haematology*. 2022 May 1;9(5):e361-73.
9. Nagler A, Labopin M, Houhou M, Aljurf M, Mousavi A, Hamladji RM, Al Zahrani M, Bondarenko S, Arat M, Angelucci E, Koc Y. Outcome of haploidentical versus matched sibling donors in hematopoietic stem cell transplantation for adult patients with acute lymphoblastic leukemia: a study from the Acute Leukemia Working Party of the European Society for Blood and Marrow Transplantation. *Journal of Hematology & Oncology*. 2021 Apr 1;14(1):53.
10. Rautenberg C, Stölzel F, Röllig C, Stelljes M, Gaidzik V, Lauseker M, Kriege O, Verbeek M, Unglaub JM, Thol F, Krause SW. Real-world experience of CPX-351 as first-line treatment for patients with acute myeloid leukemia. *Blood Cancer Journal*. 2021 Oct 4;11(10):164

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