International Journal of Research and Review
Volume 11; Issue: 4; April 2024
Website: www.ijrrjournal.com
Original Research Article *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Study of Patterns of Leukaemia in a Tertiary Care Hospital

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DOI: https://doi.org/10.52403/ijrr.20240404

ABSTRACT

Introduction: Leukaemia arises from abnormal proliferation of hematopoietic or lymphoid cells, categorized as acute or chronic and originating from lymphoid, myeloid, or mixed lineages. Clinical manifestations result from leukemic cell proliferation and tissue infiltration.
Objectives: This study aimed to determine the frequency and clinicopathological profile of leukaemia cases.
Material and Methods: A three-year cross-sectional observational study was carried out in the Department of Pathology, Indira Gandhi Medical College, Shimla. Diagnosis of Leukaemia was based on complete blood count, peripheral smear examination, bone marrow analysis and cytochemistry wherever required. Data comprising of patient details, clinical examination and haematological parameters were analysed.
Results: A total of 163 leukaemia cases were identified, including 102 (63%) acute and 61(37%) cases of chronic leukaemia. Acute leukaemia consisted of 58 cases of Acute Myeloid Leukaemia (AML), 25 Acute Lymphoblastic Leukaemia (ALL), and 19 undifferentiated leukaemia (UL), while chronic cases comprised 47 Chronic Myeloid Leukaemia (CML) and 14 Chronic Lymphocytic Leukaemia (CLL). Most patients were in the age group of 31-60 years, with a male predominance (M:F 1.7:1).
Conclusions: Early diagnosis and typing are vital for prompt leukaemia treatment. Despite advanced technologies, cytomorphological examination with cytochemistry remains crucial, especially in resource-limited settings like India.

Keywords: Leukaemia, acute, chronic, cytomorphology, observational study

INTRODUCTION

Leukaemia characterized by widespread, rapid, and disorderly proliferation of leukocytes and their precursors, results from genetic mutations in a single stem cell . These could be lymphoid, myeloid or multipotent stem cells capable of forming both. [1]

Although an uncommon disease, leukaemia has an aggressive course and exceeds as a cause of death from many of the acute communicable diseases. [2] Globally these are the 10th most common cancer, comprising 2.8% of all malignancies with a mortality of 3.4% each year. [3] Leukemia incidence varies with age, gender, ethnicity, and geography. Rates are lowest in Sub-Saharan Africa and highest in Australia and New Zealand.[4] In India, leukemia is the foremost cause of cancer-related death in children, while in developed nations, it ranks second after central nervous system neoplasms in childhood mortality.[5]

Leukemias include acute and chronic forms, originating from different types of stem

cells. Acute leukemias are characterized by a predominance of myeloid or lymphoid blasts in the peripheral blood and bone marrow, rapid onset, and a potentially fatal outcome. [6]

Acute lymphoblastic leukemia/lymphomas (ALL) consist of immature B (pre-B) or T (pre-T cells) called lymphoblasts. Leukaemia refers to widespread blood and bone marrow involvement, while lymphoma involves discrete tissue masses. [7] It is most common cancer in children and is more frequent in North compared to South and Central India. [8]

Acute Myeloid Leukemia (AML) is a heterogeneous disorder originating from either hematopoietic stem cells or lineage-specific progenitor cells. It comprises about 20% of childhood acute leukemias and 80% of adult cases. Incidence increases with age, with adults over 65 having nearly 30 times higher rates than children. AML is most prevalent in North America, Western Europe, and Oceania among adults, while Asia and Latin America have lower rates. In children, the highest incidence is in Asia, while North America and India have the lowest rates. [9]

Top of Form
Bottom of Form

Acute leukemias typically present with rapid onset and symptoms related to bone marrow suppression, such as anemia, infections, and bleeding tendencies. Generalized lymphadenopathy, splenomegaly, and hepatomegaly are common signs of organ infiltration, more prevalent in ALL, while AML often involves skin and gum infiltration by blasts. [6]

Chronic leukemias are Chronic Myeloid Leukaemia (CML) and Chronic Lymphocytic Leukaemia (CLL) and are characterized by an expanded pool of proliferating cells that retain their capacity to differentiate to end cells. [1]

Of these, CML is the most common adult leukemia in India with an annual incidence of 0.8-2.2/100,000 population in males and 0.6-1.6/100,000 population in females.[10] The median age at diagnosis in Indian population is a decade younger than West and it remains uncommon in children and adolescents with only 2.7% of CML cases occurring in younger than 20 years. [11,12]

Chronic lymphocytic leukemia (CLL), the most common lymphoproliferative disorder in the West account for about 30% of leukemias. However, its incidence (2-4%) is lower in India. [13] It is the most common form of leukemia in elderly people with a male predominance. [7]

Chronic leukemias typically start slowly with nonspecific symptoms like fatigue, weight loss, and leukocytosis with mature granulocytic/lymphoid cells. In CML, massive splenomegaly is common, along with the presence of the Philadelphia chromosome or a BCR-ABL gene fusion. [7] In CLL, generalized lymphadenopathy and hepatosplenomegaly are the presenting features which are seen in approximately 2/3rd of cases.

Leukemias vary in causes, development, prognosis, and treatment response. Detailed understanding of these differences is crucial for personalized patient care. India lacks a nationwide leukemia screening program, leading to widespread unawareness of the condition. This lack of awareness contributes to late diagnosis and non-compliance with screening guidelines.

Accurate diagnosis of leukemia relies on identifying specific biological characteristics. The FAB classification, developed by French, American, and British hematologists in 1976 and 1999, based on morphology and cytochemistry, gained global acceptance. The WHO later proposed a more comprehensive classification system in 2001 and 2008, incorporating immunophenotyping, cytogenetics, and molecular genetic analysis alongside clinical and hematological features. However, the FAB classification remains valuable for initial morphological assessment, guiding additional tests, and in under-resourced laboratories lacking immunophenotypic and genetic analysis capabilities.

Early diagnosis and classification of leukemia are crucial for initiating prompt treatment. Previous studies have investigated various aspects of leukemia, including clinical, geographical, racial/ethnic, and demographical trends, but comprehensive studies are lacking at our institute. Therefore, this study aims to analyze the spectrum of leukemias, including demographics, clinical presentation, and morphological and cytochemical types and subtypes, at Indira Gandhi Medical College, Shimla (Himachal Pradesh).

MATERIALS & METHODS

- All newly diagnosed cases of leukaemia over a course of three years were studied in the Department of Pathology, Indira Gandhi Medical College, Shimla, Himachal Pradesh.
- Follow-up cases of leukaemia were excluded for the study.
- Giemsa-stained peripheral smears were examined.
- Bone marrow aspiration and biopsy was performed as needed.
- Myeloperoxidase (MPO), Periodic Acid Schiff (PAS), and Non-Specific Esterase (NSE) stains were used for myeloid and lymphoid leukaemia subtyping when necessary.
- Clinical and haematological data was recorded and analysed for all patients of leukaemia.
- FAB morphologic classification is applied to diagnose and classify acute leukemia cases, with criteria of more than 20% blast cells for AML and 25% for ALL in peripheral smear and bone marrow aspiration. [14]
- Immunophenotyping results were documented wherever available.

STATISTICAL ANALYSIS

- The quantitative variables were analyzed using descriptive statistics such as Mean ± SD.
- The qualitative data were described in percentages & proportions.
- Chi-Square test or Fischer Exact test were used to test association between various variables.
- Two tailed significance tests were used.
- p value <0.05 was considered as statistically significant.
- The statistical software SPSS version 20.0 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows Version 20.0. Armonk NY: IBM Corp) was used for statistical analysis.

RESULT

- A total of 5,762 malignancy cases were detected during the course of study. Out of these, 0.3% (163) were of leukaemia.
- Acute leukaemia accounted for 63% (102), chronic leukaemia for 37% (61). (Table 1)
- Acute leukaemia comprised 57% AML, 24% ALL, and 19% Undifferentiated leukemia. Chronic leukaemia included 77% CML and 23% CLL cases. (Table 1).
- Most patients (55.1%) were aged 21-60 years, with 13% aged 11-20 years.
- CML was the most prevalent leukaemia in adults, followed by AML, CLL, and ALL. (Table 2)
- •Males outnumbered females (M:F 1.7:1) across all leukemia types. (Table 3)

Table 1. Distribution of Leukaemia Patients (n=163)

Type	Total number n=163	Percentage (%)
Acute leukaemia		
ALL	25	24%
AML	58	57%
Undifferentiated leukaemia	19	19%
TOTAL	102	100%
Chronic leukaemia		
CML	47	77%
CLL	14	23%
TOTAL	61	100%

Table 2. Age Distribution in Various types of Leukaemia

AGE (yrs)	ALL (n=25)	AML (n=58)	UL (n=19)	CML (n=47)	CLL n=14	Total n %	
<10	14	3	1	0	0	18	11%
11-20	9	7	6	0	0	22	13.5%
21-30	1	6	5	6	0	18	11%
31-40	1	9	1	10	1	22	13.5%
41-50	0	8	3	10	4	25	15.3%
51-60	0	9	0	12	4	25	15.3%
61-70	0	8	2	7	1	18	11%
71-80	0	4	1	2	3	10	6.2%
81-90	0	3	0	0	1	04	2.5%
>90	0	1	0	0	0	01	0.7%

Table 3. Sex Distribution in Different Leukaemia

Type	Male (n=103)	Female (n=60)	Z- test	p – value*
Acute leukaemia				
ALL	19	6	1.901	0.06
AML	32	26	1.10	0.27
UL	10	09	0.70	0.47
TOTAL	61	41	1.159	0.25
Chronic leukaemia				
CML	32	15	0.23	0.81
CLL	10	04	0.23	0.81
TOTAL	42	19	1.159	0.25

***p-value <0.05 = significant**

There was no significant difference between proportion of males and females for acute and chronic leukemias.

ACUTE LEUKAEMIA

- AML patients' ages ranged from 2 to 96 years, with a mean of 44.5 ± 23.3 years, predominantly in the 21–70 age group. (Table 2)
- ALL primarily occurred in patients under 20 years, while AML exhibited a wider age range. (Table 2)
- Among acute leukemia cases, males constituted 60% (61) and females 40% (41) (M: F 1.43:1). (Table 3)
- Majority of acute leukaemia patients presented with weight loss, weakness, fever and pallor. Lymphadenopathy was seen in 83% (21) cases of ALL and 33% (19) cases of AML. Bleeding as clinical manifestation was present in 26% (27) cases of acute leukaemias. Gum hypertrophy and disseminated intravascular coagulation (DIC) were seen exclusive to AML cases. (Table 4)

Table 4. Clinical Findings in Acute Leukaemias

Clinical feature	ALL (n=25)		AML (n=58)		UL (n=19)	
	n	%	n	%	n	%
Weight loss	22	88%	55	98%	19	100%
Fever	21	84%	50	86%	15	79%
Pallor	21	84%	52	90%	17	89%
Hepatomegaly	14	56%	40	69%	9	47%
Splenomegaly	16	64%	42	72%	14	74%
LAP	21	84%	19	33%	1	5%
Bleeding	7	28%	17	29%	3	16%
Bony tenderness	6	24%	0	0	0	0
Gum hypertrophy	0	0	2	3%	0	0
DIC	0	0	1	2%	0	

- The mean hemoglobin concentration of acute leukaemia patients was 8.1 ± 3.2 g/dl. Anemia (Hb <11g/dl) was seen in 96 % (24) cases of ALL and 93 % (54) of AML.
- The mean TLC was 36660 ± 39712.1/mm^3 among ALL and 31470.3 ± 40872.7 among AML. Majority of the patients of ALL and AML presented with leukocytosis (35 AML; 17 ALL; 14 UL) followed by leukopenia (16 AML;

4 ALL; 2 UL) and TLC within normal limits (7 AML; 4 ALL; 13 UL).

- The mean platelet count of patients was 67286±42965/ µL in ALL and 74226 ± 64619 in AML. Thrombocytopenia was observed in patients 44 patients of AML and 19 patients of ALL. Platelet count was normal in 14 cases of AML and 6 cases of ALL. (Table 5)

Table 5. Laboratory Parameters in Acute Leukaemias

Parameters	ALL (n=25)	AML (n=58)
Mean age in years	11±8	45±23
Age range in years	2-38	7-96
Mean Hb in g/dl ± SD	6.1 ± 2.3	7.4 ± 2.2
Mean TLC/µl ± SD	36660±39712	31470±40873
Mean platelet count/µl ± SD	67286±42965	74226±64619

Subtypes of Acute myeloid leukaemia (AML)

- Among AML, M2 (46%) was the most frequent type, followed by M3 (19%), M1 (12%), M5 (10%), M4(9%), M6(2%) and M7 (2%). (Table 6)

Table 6. AML Frequency and Sex Distribution

Type & subtype	Male (n=32)	Female (n=26)	Frequency	
AML (n=58)	n	n	n	%
M1	3	4	7	12%
M2	14	13	27	46%
M3	4	7	11	19%
M4	5	0	5	9%
M5	4	2	6	10%
M6	1	0	1	2%
M7	1	0	1	2%
TOTAL	32		58	100

Cytochemistry in AML

- Forty-two (42) cases of AML showed MPO positivity. Whereas 9 cases were MPO negative.
- Nonspecific esterase (NSE) positivity was demonstrated in 11 cases of AML.

Subtypes of Acute lymphoblastic tumor (ALL)

- Out of all cases of ALL, L2 76% (19/25) was the most common type detected, followed by L1 20% (5/25) and L3 4% (1/25). (Table 7)

Table 7. Sex And Frequency Distribution of ALL

ALL Subtype	Male		Female		Frequency	
	n	%	n	%	n	%
ALL L1	5	20%	0	0	5	20%
ALL L2	13	52%	6	24%	19	76%
ALL L3	1	4%	0	0	1	4%
TOTAL	19	76%	6	24%	25	100

Cytochemistry in ALL: Among ALL (25), PAS positivity in the blasts was observed in 19 cases. Whereas 6 cases were PAS negative.

Immunophenotyping in ALL:

Immunophenotyping was done in 22 (88%) patients of ALL and all cases were of B cell phenotype.

CHRONIC LEUKAEMIAS

- Out of all chronic leukaemia (61), CML 77% (47) was more in frequency than CLL 23% (14). (Table 1)
- Male patients constituted 69% (42), with a male-to-female ratio of 2.2:1. Male predominance was seen in both CML (M: F=2:1) and CLL (M:F=2.5:1). (Table 3)
- The age of the patients varied from 25 to 78 (mean 48±14) years among CML and

32 to 82 (mean 58±15) years among CLL.

- No cases of CML and CLL were detected in children in our study.
- The maximum patients of both CML and CLL were in 31-60 years of age. (Table 2)
- All cases of CML in the study group were positive for BCR-ABL translocation.
- Like acute leukaemia, weight loss and fever were the most frequent clinical presentations in chronic leukaemia. Splenomegaly was seen in 96% (45) cases of CLL and 71% (10) cases of CLL. Eighty six percent (12) cases of CLL had lymphadenopathy (LAP) during hospital admission. While only 7% (3) of CML cases had LAP. (Table 8)

Table 8. Clinical Features in Patients of CML AND CLL

Clinical features	CML (n=47)		CLL (n=14)	
	n	%	n	%
Weight loss	45	96 %	13	93%
Fever	25	53%	10	71%
Pallor	36	62%	06	43%
Hepatomegaly	25	53%	08	57%
Splenomegaly	45	96%	10	71%
Lymphadenopathy	3	7%		86%

- Mean haemoglobin (Hb) in CML patients was 9.1 ± 3.4 gm/dl in CML and 9.6 ± 4 gm/dl in CLL patients. Maximum TLC was observed in CML group was maximum i.e. 105757±89855/µl, followed by CLL group with mean TLC of 46267±34327. CML patients had mean platelet count of 276686±370006/µl while CLL patients had 161415±138584/µl. Majority (74%) of patients of CML presented in chronic phase of disease. (Table 9)

Table 9. Hematological Parameters in Chronic Leukaemia

Parameters	CML (n=47)	CLL (n=14)
Mean age in years	48±14	58±15
Age range in years	25-78	32-82
Mean Hb in g/dl ± SD	9.1 ± 3.4	9.6 ± 4
Mean TLC/µl ± SD	105757±89855	46267±34327
Mean platelet count/µl ± SD	276686±370006	161415±138584

DISCUSSION

Hematological malignancies are common and affect all ages and genders. It is one of leading causes of death worldwide especially in pediatric age group.

Leukaemia is one of the most diagnosed cancers worldwide and is estimated to have the 11th highest incidence of all cancers. [15]

The diagnosis of leukemias involves multiparameter approach including morphologic examination and phenotypic or genotypic studies.

In many studies across India and neighboring countries, acute leukemias have a higher incidence compared to chronic leukemias, consistent with findings by D'Costa GG et al. [16] (58%), Hassan K *et al* [17] (62.8%), Bera K *et al* [5] (59%), Laishram RS *et al* [3] (85%), Salkar AB *et al* [18] (64.5%), and Kulshreshtha R *et al* [19] (62%). Our study aligns with these observations. However, Prasad C *et al* [20] and Mannan R *et al* [21] found chronic leukemias to be more frequent than acute leukaemias.

There is difference in distribution of various types of leukemias as observed in different studies and this could be attributed to geographical variation.

Incidence of myeloid type of leukaemia is more as compared to lymphoid type and this has been confirmed by studies that were done in India and other South-east Asian countries over the past many years. [3,5,16,18,19,20]

Among these, Acute Myeloid Leukaemia (AML) was more common than CML in studies by Laishram *et al* [3] 54 (52.4%), Salkar AB *et al* [18] 43 (39%) and in present study 58 (36%). While, Kulshreshtha *et al* [19], Prasad C *et al* [20] Rathee R *et al* [8] and Bera K *et al* [5] reported higher number of CML cases in their respective studies.

There is no uniformity among age groups with maximum number of leukaemia patients as Laishram RS *et al* [3] observed the highest number of leukaemia cases in 0-10 years (27%), Prasad C *et al* [20] in 31-50 years (61.8%) , Salkar *et al* [18] in 41-50 years (21%) and Bera K *et al* [5] in 11-20 years of age.

The age range in our study group varied from 2 to 96 years which is similar to studies by Laishram RS *et al* [3] (9 mn to 79 yr) and Prasad C *et al* [20] (14 mn to 72 yr).

Leukemias affect males more commonly than females as has been documented in literature. The reason of male predilection in leukemias can be linked to lifestyle and habits like tobacco smoking other than genetic factors.[5] However, this seems to be the not only explanation for the patterns seen within our data, as the male excess is evident in children too who are devoid of such lifestyle influences. Overall male predilection in cases of leukaemia was observed by D'Costa GG *et al* [16] (1.7:1), Kulshreshtha R *et al* [19] (1.8:1), Salkar AB *et al* [18](1.8:1), Bera K *et al*[5] (1.8:1) and our finding was in accordance with these (1.7:1).

ACUTE LEUKAEMIAS

Acute leukaemia comprises a heterogenous group of diseases which are characterized by rapid and uncontrolled expansion of progenitor cells of the hematopoietic system. [22]

Among acute leukemias, AML (57%) was more in frequency than ALL (24%) in our study which is comparable to some other studies done in India [3,5,8,18] and Nepal [19] but dissimilar to Prasad C *et al* [20] and Bera K *et al* [5] who found higher incidence of ALL as compared to AML.

We found the incidence of acute leukaemia to be more (32%) in younger age group (0-20 years) similar to the findings of Laishram RS *et al* [3] (52%) and Bera *et al* [5] (42%).

Consistent with published data, our study found acute leukaemias to be higher in males as compared to females (M:F=1.5). [5,8,19]

Acute myeloid leukaemia (AML)

AML are a group of heterogenous disorders with respect to morphologic, immunophenotypic and cytogenetic features. AML has an incidence of 2-3 per one lakh per annum in children, rising to 15 per lakh per year in older adults. [23] Approximately 9200 cases of AML are diagnosed in United States each year and it accounts for 80-90% of all acute leukaemia cases in adults. [9] It was the commonest type of leukaemia detected in present series and constituted 36% of all the cases.

AML occurs at all ages, but the incidence rises throughout life, peaking after 60 years of age. [7] In the present study, AML was seen distributed over a wide age range (7-96 yrs) which is like studies by Laishram RS *et al* [3], Bera K *et al* [5] and Jain A *et al* [23].

Male predominance in AML cases is well documented in literature. However, occasional studies from Northern England [24] and Sweden [25] found no inclination for either gender while a single study from Brazil [26] has shown higher female incidence. Rathee R *et al* [8] (M:F=1.9:1), Bera K *et al* [5] (M:F=2.2:1), Jain A *et al* [23] (M:F=1.5:1) have observed male preponderance in their studies and our finding (M:F =1.2) is in accordance with these.

Most patients of AML present within weeks or a few months of the onset of symptoms with complaints related to anemia, neutropenia, and thrombocytopenia. [7] Our findings of fever and pallor as the most common clinical presentation are comparable to Jain A *et al* [23].

Lymphadenopathy although not commonly seen in AML patients was observed in 36%

of Ghosh S *et al* [9] , 37% of Jain *et al* [23], and 32% of our study subjects. Thrombocytopenia results in a bleeding diathesis which was seen in 15% cases of Jain *et al* [23] and 29% cases in present study. Soft tissue infiltration by blast cells of AML in the form of gum hypertrophy was seen in two cases. While no such cases were reported by studies by Ghosh S *et al* [9] and Jain A *et al* [23].

In all AMLs the accumulation of proliferating neoplastic myeloid precursor cells in the marrow suppresses remaining normal hematopoetic progenitor cells by physical replacement as well as by other unknown mechanisms. The failure of normal haematopoiesis results in anemia, neutropenia, and thrombocytopenia. [7]

Anemia among AML patients in the present study was of normocytic normochromic type and correlates well with other studies. [8,18,23]

The mean TLC in our study was 31470/µl whereas other studies [8,23] have mean TLC more than 40000/µl with Salkar AB et al [18] having the highest mean TLC of 79635/µl.

Thrombocytopenia was seen in 76% (44) cases of present series. The mean platelet count in present study (74226/µl) is comparatively more than that observed by studies by Salkar AB *et al* [18](65930/µl), Rathee R *et al* [8] (67000/µl) and Jain A *et al* [23] (58000/µl).

Subtype of AML (FAB Classification)

Among AML M2 is most common subtype as seen by Ghosh S *et al* [9] (34%), Kulshreshta R *et al* [19] (53%), Chen BA et al [27] (36.2%), Sadiq MA et al [28] (42%) and Salkar AB *et al* [18] (44%).

Our observation was similar to these studies but different than Laishram *et al* [3] who found M3 (38%) to be the commonest subtype .

M0 is least common as observed by various workers in literature. Jain A *et al* [23] reported one case of M0 subtype while no case of M0 was detected in present and other series.

M6 and M7 are the rare subtypes of AML and in most studies occasional cases are recorded including Kulshreshtha R *et al* [19] and Jain A *et al* [23] who recorded only one case of M6 in their respective studies. We reported one case of M7 in our study while none was reported by other authors. [19,23]

Cytochemistry in AML

Leucocyte cytochemistry is useful to distinguish ALL from AML and for characterization of immature cells in AML. Eighty four percent cases in present series and 93% in Salkar AB *et al* [18] were positive for MPO and negative for PAS. NSE and MPO positivity were seen in 12% cases of our study in 5% cases of Salkar *et al* [18] . NSE positivity with MPO negativity were present in 7% of cases while no similar case was reported by Salkar *et al* [18].

Acute lymphoblastic leukaemia (ALL)

ALL is the most common malignant disease affecting children and accounts for approximately 30% of childhood cancers. ALL is the most prevalent cancer among children and adolescents in the United States, representing 20% of all cancers diagnosed in persons less than 20 years of age. [29]

ALL occurs predominantly in childhood and this fact is supported by our finding. Eighty four percent (84%) of our patients were under 20 years of age with mean age of 10.9 years and similar results were obtained by Laishram RS *et al* [3] and Bera K et al [5].

Seigel DA *et al* [30] in their study on trends of paediatric acute lymphoblastic leukaemia found the incidence of ALL to be highest (75.2 per 1 million) in children aged 1-4 years age. We however, found no similar findings.

Consistent with published data, this analysis also found the incidence of ALL higher among males as compared to females (M:F=3.1:1). [5.8.19,31]

Children with ALL usually present with manifestations related to bone marrow and organ infiltration by leukemic cells. Fever and pallor were the most clinical finding.

Pallor, hepatomegaly, splenomegaly, and Lymphadenopathy as clinical presentation in present study was comparable to Yasmeen N *et al* [31].

Bony tenderness due to periosteal and bone involvement was seen in 24% of our study subjects.

CNS manifestations due to meningeal spread are more common in patients of ALL. Yasmeen N *et al* [31] observed CNS disease in 5% of cases while we observed no such case in our study.

Anaemia which may be severe is usually present in all cases of ALL. Yasmeen N *et al* [31] observed severe anaemia (<7g/dl) in 54% of patients. We observed anaemia in 99% (24) of ALL cases with mean Hb of 6.1g/dl and similarly Salkar AB *et al* [18] and Rathee R *et al* [8] found moderate to severe anaemia in most of their patients. Total leukocyte count may be raised, normal or low. Mean TLC in present study was 36660/µl which is low in comparison to findings by Salkar AB et al [18] (62060/µl) and Rathee et al [8] (70000/µl).

Thrombocytopenia was present in our 80% cases of ALL with a mean platelet count of 67268/µl which is slightly higher than that observed by other studies. [8,18]

Subtype of ALL

ALL L2, followed by L1, and L3 was the most frequent subtype of ALL in present study and similar pattern was reported by Kulshreshta R *et al* [19], Laishram RS *et al* [3], Salkar AB *et al* [18] .

Cytochemistry in ALL

Cytochemistry is an adjunct to the morphological examination in cases of ALL. Seventy six percent cases in our and 93% cases in Salkar AB et [18] al study were PAS positive and MPO negative while rest of the cases were both PAS and MPO negative.

By immunophenotyping analysis, various subtypes (T or B cell) of ALL could be identified. In study done by Siddiqui RP *et al* [32] *58*% cases were of B-cell lineage and rest were T-cell lineage. However, in present series all cases were of B- cell lineage on immunophenotyping.

CHRONIC LEUKAEMIAS

Chronic leukaemias are characterized by an expanded pool of proliferating cells that retain their capacity to differentiate to end cells. [1] Among these, CML 77% (47) was more frequent than CLL 23% (14) as observed in studies done in various regions of Indian and other Asian Studies. [3,5,16,18,20] However, in studies from Western countries CLL is more common than CML. [33] Like in acute leukaemias, male preponderance in cases of chronic leukaemias was seen in observed in series as well as by other authors. [5,8,18]

Chronic Myeloid Leukaemia (CML)

Chronic myeloid Leukemia (CML) is a clonal disorder resulting from an acquired genetic abnormality in a multi-potential haemopoietic stem cell. It is the most common adult leukaemia in India accounting for 30-60% of all adult leukaemia. [9,12 ,34]

It is seen in a younger population, the median age at onset being between 30 – 40 yrs. [10] Median age at presentation in India is a decade younger (55yr) compared with Western literature (66yr). [11,12]

Bera *et al* [8] (62%) and Shittu AO *et al* [48] (74%) observed maximum number of CML patients in 21-60 years of age which is like our observation (81%). The mean age of CML patients in our study is 48 years (range 25-78 yrs) and 38.3 years (range 17-68 yrs) in study done by Shittu AO et al [35].

Worldwide approximately 3% of childhood leukemias are CML, with a 10% incidence in children ages 5 to 20 years. [29] While some studies [3,5,35] reported CML cases in pediatric age group, we found none in our study.

The male to female ratio (2.1:1) in CML patients in our study cohort points towards the gender bias as seen in various other malignancies. Other authors also found increased incidence of CML among male population in their respective studies. [5,8,19]

Most patients of CML in our study were symptomatic which is different from Western data where symptomatic diagnosis of CML is lower. [36] Splenomegaly was seen in 96% cases of study by Shitto AO et al [35] and similar findings were observed in present study.

Anaemia is present in virtually all patients at diagnosis and is usually mild to moderate in degree. It was present in 64% (30) of our CML patients but mean Hb was higher (9.1g/dl) as compared to Shittu AO *et al* [35](7.3g/dl) and Salkar AB *et al* [18] (8.4g/dl).

Total leucocyte count is moderately to markedly increased and is commonly more than 1,00,000/µl as seen by Shittu AO *et al* [35] (167800/µl) and Salkar AB et al [18] (138110/µl). We observed similar finding in our study (105757/µl).

Mild to moderate thrombocytosis may be seen in patients of CML. It was seen in 13% (6) patients of Shittu AO et al [35] and 15% (7) patients in present study.

CML is characterized by an initial chronic stable phase which may progress to blast crisis within 3-5 years.

In present study, majority (73%) of patients at the time of presentation were in the chronic phase which is similar to Shittu AO et al [35] (83%) and Malhotra P et al [37] (85%).

Chronic Lymphocytic Leukaemia (CLL)

Chronic lymphocytic leukaemia (CLL) is the most common form of leukaemia amongst adults in the west, accounting for 30% of all leukaemias, but is uncommon in India. [12] The lower incidence of CLL in India might be due to lower life expectancy in the Indian population (64 yrs) as compared to the West (76yrs). [33]

CLL is a disease of the elderly population and the mean age in study by Gogoi A *et al* [12] is 59yrs and 58 years in our study.

We reported no patient of CLL in paediatric age group and our finding were consistent with that of Laishram R *et al* [3] and Bera K *et al* [5].

There is male predominance in CLL cases as evidenced in various studies and this may be attributed to the fact that males are comparatively more exposed to occupational and environmental carcinogens. In western studies the sex ratio has been reported as M:F=1.5-2:1[12] which is comparatively lower than present study (2.5:1) as well as other studies previously done in India [5,8,13,33] and Nepal [19].

The most common presenting symptom was lymphadenopathy in studies from the West [38,39]. Hepatomegaly and splenomegaly were seen in 57% and 71% in the present study as compared to 40.36% and 50.9% in Gogia A *et al* [13] and 63% and 66% in Agrawal N *et al* [33].

Anemia in CLL develops with progressive marrow replacement by tumor cells and is normocytic normochromic. In present study mean levels of hemoglobin was 9.6g/dl which is intermediate to that in Salkar AB *et al* [18] (7.3g/dl) and Gogia A *et al* [13] (11.5g/dl).

The mean white blood cell count was 46267/µl in this study which is lower than that reported by Agrawal N *et al* [33] (70600/µl), Gogia A *et al* [13] (50000/µl) and Salkar AB *et al* [18] (61466/µl).

Platelet count may be normal or decrease. The mean platelet count in our study was comparable to other studies. [13,18]

CONCLUSION

This study highlights leukemia as a prevalent haematological disorder affecting all age groups. Peripheral blood and bone marrow examination, along with cytochemistry, suffice for early diagnosis, particularly in resource-limited settings like India. Flow cytometry and immunophenotyping enhance diagnostic accuracy in inconclusive cases.

Acute leukaemias are more common in both children and adults, while CML and CLL are exclusively adult-onset. Male predominance is noted in both acute and chronic leukaemia. Most patients present with anaemia, high leukocyte count, and

low platelet count, though sub leukemic cases are also observed.

Leukaemias vary in aetiology, pathogenesis, prognosis, and treatment response, necessitating detailed characterization for optimal patient management. Large population-based studies are crucial to understand regional leukemia trends better. Nonetheless, this study sheds light on leukemia patterns in this region, where data are scarce

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: I would like to extend my deepest gratitude to Indira Gandhi Medical College, Shimla for providing me with the necessary resources, facilities, and support throughout the duration of this study. I am particularly thankful to the faculty members and staff for their guidance, encouragement, and invaluable insights that enriched my learning experience.

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Anantika Thakur, Rajni Kaushik, Anchana Gulati. Study of patterns of leukaemia in a tertiary care hospital. *International Journal of Research and Review*. 2024; 11(4): 28-40. DOI: *10.52403/ijrr.20240404*

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