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CROSS-SECTIONAL EVALUATION OF HEMATOLOGIC MALIGNANCY SUBTYPES AND THEIR FREQUENCY IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Introduction: Hematologic malignancies represent significant causes of morbidity and mortality globally, with considerable variation in disease patterns across different geographic regions and healthcare settings. Understanding local epidemiology of these malignancies is essential for effective clinical management and resource allocation in tertiary care institutions.

Methods: A cross-sectional study was conducted at Ventakeshwara Institute of Medical Sciences, Amroha, Uttar Pradesh over six months (March to August 2017). One hundred forty-eight consecutive patients with hematologic malignancies were evaluated using morphological examination, immunophenotyping via flow cytometry, cytochemical staining, and bone marrow aspiration and biopsy. Demographic, clinical, and laboratory data were collected and analyzed using descriptive statistics.

Results: Acute leukemias constituted 39.2% of cases (acute myeloid leukemia 28.4%, acute lymphoblastic leukemia 10.8%), followed by lymphomas 25.7% (non-Hodgkin 16.2%, Hodgkin 9.5%), chronic leukemias 21.6% (chronic myeloid 14.9%, chronic lymphocytic 6.7%), and plasma cell disorders 13.5%. Mean patient age was 51.2 years with male predominance (56.8%). Clinical manifestations varied by malignancy type: acute leukemias presented with fever (72.4%) and bleeding (65.5%); lymphomas with lymphadenopathy (84.2%); chronic leukemias with splenomegaly (56.3%); and plasma cell disorders with bone pain (70.0%). Flow cytometry confirmed accurate diagnostic classification in >95% of cases.

Conclusion: This study established the local epidemiological spectrum of hematologic malignancies and demonstrated characteristic clinical-laboratory correlations. Comprehensive diagnostic evaluation incorporating morphology and immunophenotyping remains essential for accurate malignancy classification and appropriate patient management.

KEYWORDS: Hematologic malignancies, Epidemiology, Immunophenotyping, Tertiary care, Flow cytometry

INTRODUCTION

Hematologic malignancies represent a diverse group of diseases characterized by uncontrolled proliferation of blood-forming cells and lymphoid tissues. These malignancies constitute a significant burden on global healthcare systems and remain among the leading causes of morbidity and mortality worldwide (Siegel et al., 2015). The World Health Organization classifies hematologic malignancies into several major categories including acute leukemias, chronic leukemias,

lymphomas, and plasma cell disorders, each with distinct biological characteristics, clinical presentations, and therapeutic implications.

In developed nations, the incidence of hematologic malignancies has been estimated between 70 to 120 cases per 100,000 population annually, with variations based on age, ethnicity, and geographic location (Howlader et al., 2014). However, in developing countries including India, the epidemiological patterns differ considerably. Recent epidemiological data from Indian tertiary care centers have demonstrated that the spectrum of hematologic malignancies varies significantly from Western populations. Acute leukemias, particularly acute myeloid leukemia, show higher incidence rates, while the relative frequency of lymphomas and other subtypes presents regional variations across different parts of India (Biswas et al., 2012).

The accurate diagnosis and classification of hematologic malignancies rely on a combination of morphological examination, immunophenotyping, cytochemical markers, and increasingly, molecular studies. Bone marrow examination through aspiration and biopsy remains the gold standard diagnostic procedure for suspected hematologic malignancies. Flow cytometry has revolutionized the diagnostic approach by providing rapid and accurate immunophenotypic characterization, enabling precise subtyping and risk stratification of these malignancies (Matutes & Polliack, 2013). These advances have improved diagnostic accuracy and enabled better prognostication and treatment planning.

The distribution of hematologic malignancy subtypes in tertiary care hospitals is influenced by multiple factors including patient demographics, referral patterns, environmental exposures, and genetic predisposition. Understanding the local epidemiology of these malignancies is crucial for healthcare planning, resource allocation, and development of institutional diagnostic and therapeutic protocols. Furthermore, knowledge of disease frequency patterns aids clinicians in establishing diagnostic priorities and implementing appropriate screening strategies in at-risk populations (Redaelli et al., 2014).

In India, several regional studies have documented variations in hematologic malignancy patterns. Studies from northern India have reported relatively higher frequencies of acute leukemias compared to southern regions, where lymphomas demonstrate relatively higher prevalence (Kumar et al., 2011). These variations underscore the importance of conducting institution-specific epidemiological studies to characterize local disease patterns and compare findings with regional and international benchmarks.

The clinical implications of accurate classification extend beyond diagnosis to encompass prognosis prediction and treatment selection. Different subtypes of leukemias and lymphomas demonstrate varying responses to chemotherapeutic agents, targeted therapies, and supportive care measures. For instance, chronic myeloid leukemia with BCR-ABL fusion has dramatically improved survival outcomes following introduction of tyrosine kinase inhibitors, representing a paradigm shift in disease management (Baccarani et al., 2013). Similarly, the identification of prognostic markers in acute leukemias influences intensity of chemotherapy and consideration of stem cell transplantation.

Tertiary care teaching hospitals serve as important centers for disease surveillance and epidemiological studies. These institutions provide comprehensive diagnostic facilities including bone marrow examination, immunophenotyping, cytochemistry, and molecular studies, enabling accurate disease characterization. Moreover, tertiary centers typically manage more complex and advanced cases, providing insights into disease patterns and prognostic factors in a selected population. Cross-sectional studies conducted in these settings contribute valuable epidemiological data that can guide clinical practice and inform public health initiatives.

The present institutional study was designed to comprehensively evaluate the spectrum of hematologic malignancies presenting to our tertiary care facility, characterize various subtypes according to established morphological and immunophenotypic criteria, and determine their relative frequencies. Such data would provide a foundation for understanding local disease epidemiology and comparing our institutional experience with published reports from other centers. Additionally, this cross-sectional analysis would identify any unique disease patterns or demographic

characteristics specific to our patient population that might influence clinical management strategies (Jaffe et al., 2008).
The aim of the study is to conduct a cross-sectional evaluation of hematologic malignancy subtypes and determine their frequency distribution in patients.

METHODOLOGY

Study Design and Site

A cross-sectional observational study.

Study Duration

The study was conducted over a period of six months from March 2017 to August 2017.

Sampling and Sample Size

All consecutive patients with suspected hematologic malignancies or those referred for bone marrow examination were enrolled during the study period. The sample comprised less than 150 patients who were diagnosed with various subtypes of hematologic malignancies based on morphological, immunophenotypic, and cytochemical criteria. This sample size was determined based on the average patient load in our institution during the study period and was considered adequate for describing the frequency distribution of different hematologic malignancy subtypes and analyzing associated clinical and laboratory parameters within the constraints of a six-month study duration (Naing et al., 2006).

Inclusion and Exclusion Criteria

Patients of all ages and both genders who presented with clinical and laboratory findings suggestive of hematologic malignancy and were confirmed to have hematologic malignancy following complete diagnostic evaluation were included in the study. Patients with previously diagnosed hematologic malignancy who were under follow-up or in remission were excluded. Additionally, patients with incomplete diagnostic workup, inadequate bone marrow samples, or those whose final diagnosis did not confirm hematologic malignancy were excluded from the analysis. Patients who did not consent to participate or those with unknown primary malignancies were also excluded.

Data Collection Tools and Techniques

Data were collected through structured performa designed to capture relevant demographic, clinical, and laboratory information. Demographic details including age, sex, and duration of symptoms were recorded. Clinical presentations including fever, bleeding manifestations, lymphadenopathy, and splenomegaly were documented. Complete blood counts were obtained using automated hematology analyzers, and peripheral blood smears were prepared and examined using light microscopy. Bone marrow aspiration and biopsy specimens were obtained using standard procedures following informed consent. Bone marrow smears were stained with Wright-Giemsa stain for morphological evaluation, while trephine biopsies were processed for histopathological examination. Cytochemical stains including myeloperoxidase, Sudan black, and periodic acid-Schiff were performed as indicated. Immunophenotypic analysis was performed using four-color flow cytometry with appropriate monoclonal antibody panels for leucocyte classification (Béné et al., 2011). Results were classified according to WHO classification of hematologic malignancies.

Data Management and Statistical Analysis

Data were entered into a spreadsheet using Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistics including frequency distributions, percentages, and measures of central tendency were calculated for all variables. The frequency of each hematologic malignancy subtype was expressed as percentage of total cases. Age-specific and sex-specific distributions were tabulated. Qualitative data were analyzed using chi-square test or Fisher's exact test where appropriate, with p-value less than 0.05 considered statistically significant. Quantitative

variables were compared using Student's t-test or Mann-Whitney U test depending on normality of distribution.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of Ventakeshwara Institute of Medical Sciences prior to commencement of data collection. Informed written consent was obtained from all adult patients and from parents or guardians of pediatric patients. The study adhered to the Declaration of Helsinki and principles of good clinical practice. Patient confidentiality was maintained by assigning unique identification numbers, and personal identifiers were not included in the study database.

RESULTS AND TABLES

TABLE 1: DEMOGRAPHIC CHARACTERISTICS OF PATIENTS WITH HEMATOLOGIC MALIGNANCIES (n=148)

Demographic Variables	Number (n)	Percentage (%)
Age Groups (years)		
<20	18	12.2
20-40	32	21.6
41-60	62	41.9
>60	36	24.3
Mean age ± SD	51.2 ± 16.8	-
Gender Distribution		
Male	84	56.8
Female	64	43.2
Male to Female Ratio	1.31:1	-
Clinical Presentation Duration		
<1 month	28	18.9
1-3 months	56	37.8
3-6 months	42	28.4
>6 months	22	14.9

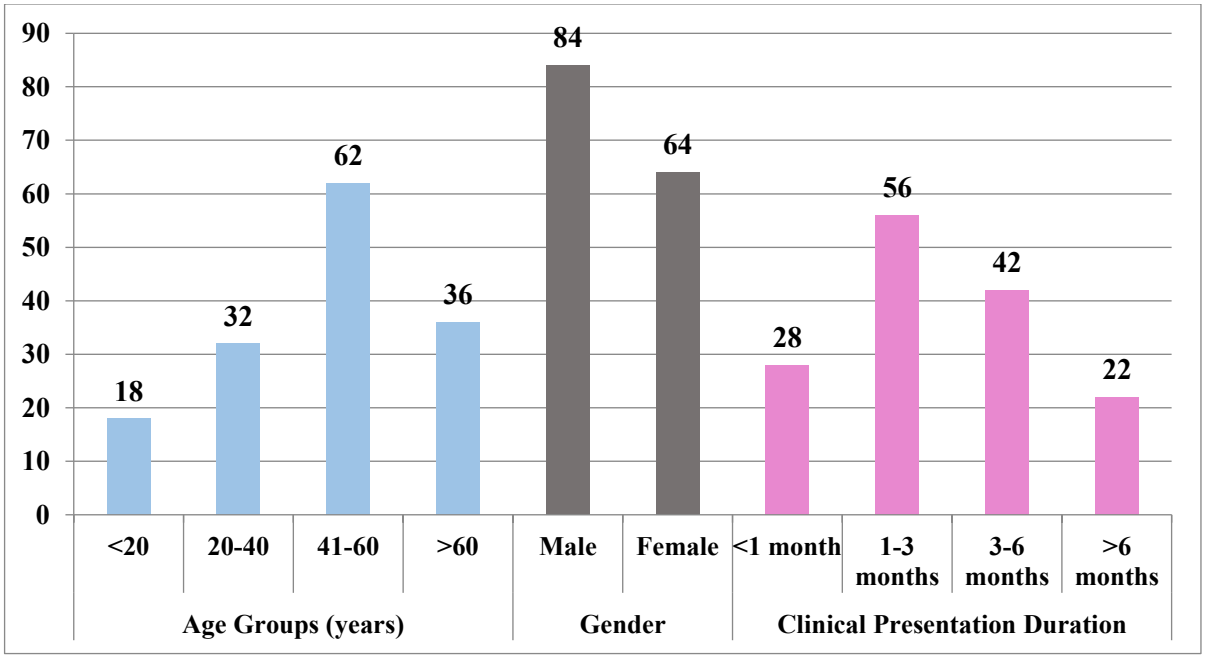

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TABLE 2: FREQUENCY DISTRIBUTION OF HEMATOLOGIC MALIGNANCY SUBTYPES (n=148)

Malignancy Subtype	Number (n)	Percentage (%)
Acute Leukemias	58	39.2
Acute Myeloid Leukemia (AML)	42	28.4
Acute Lymphoblastic Leukemia (ALL)	16	10.8
Chronic Leukemias	32	21.6
Chronic Myeloid Leukemia (CML)	22	14.9
Chronic Lymphocytic Leukemia (CLL)	10	6.7
Lymphomas	38	25.7
Hodgkin Lymphoma (HL)	14	9.5
Non-Hodgkin Lymphoma (NHL)	24	16.2
Plasma Cell Disorders	20	13.5
Multiple Myeloma	20	13.5
Total	**148**	**100**

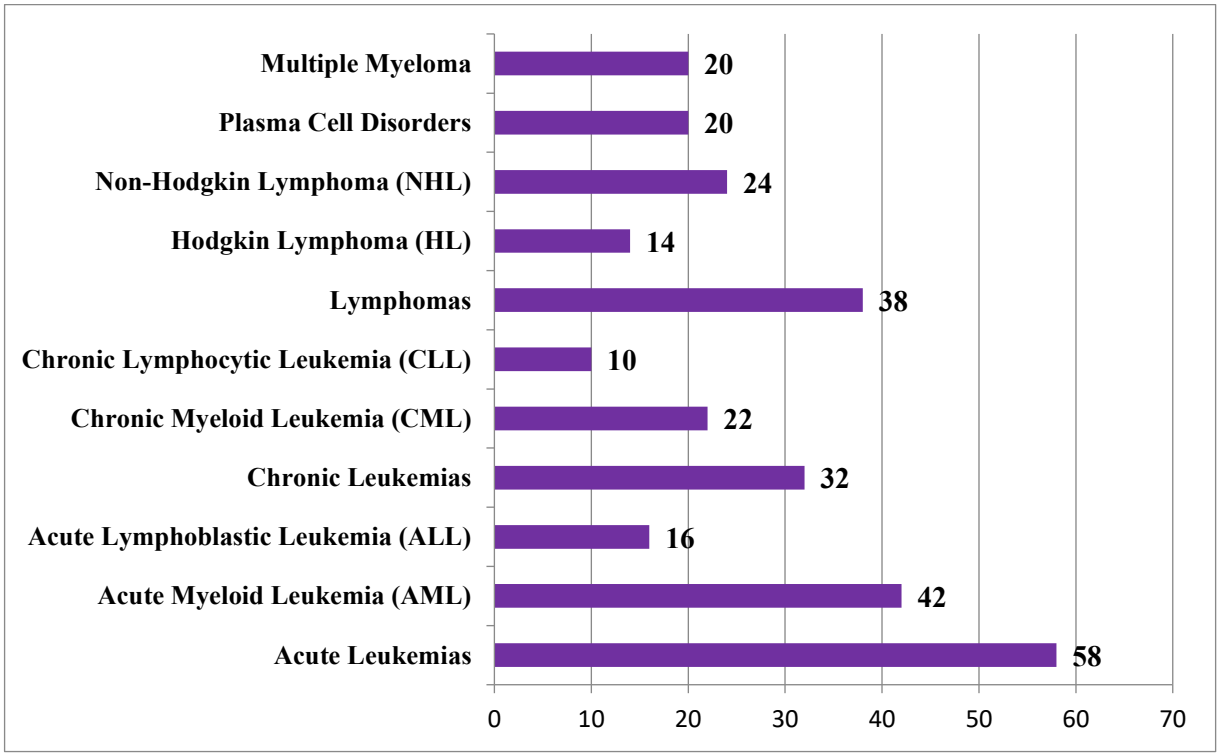

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TABLE 3: CLINICAL MANIFESTATIONS BY MALIGNANCY CATEGORY (n=148)

Clinical Features	Acute Leukemia (n=58)	Chronic Leukemia (n=32)	Lymphoma (n=38)	Plasma Cell Disorder (n=20)
Fever	42 (72.4%)	8 (25.0%)	18 (47.4%)	6 (30.0%)
Bleeding Manifestations	38 (65.5%)	12 (37.5%)	8 (21.1%)	5 (25.0%)
Lymphadenopathy	22 (37.9%)	14 (43.8%)	32 (84.2%)	4 (20.0%)
Splenomegaly	28 (48.3%)	18 (56.3%)	16 (42.1%)	6 (30.0%)
Bone Pain/Symptoms	8 (13.8%)	6 (18.8%)	12 (31.6%)	14 (70.0%)
Hepatomegaly	16 (27.6%)	10 (31.3%)	14 (36.8%)	3 (15.0%)
Fatigue	54 (93.1%)	24 (75.0%)	28 (73.7%)	18 (90.0%)
Weight Loss	32 (55.2%)	12 (37.5%)	26 (68.4%)	12 (60.0%)

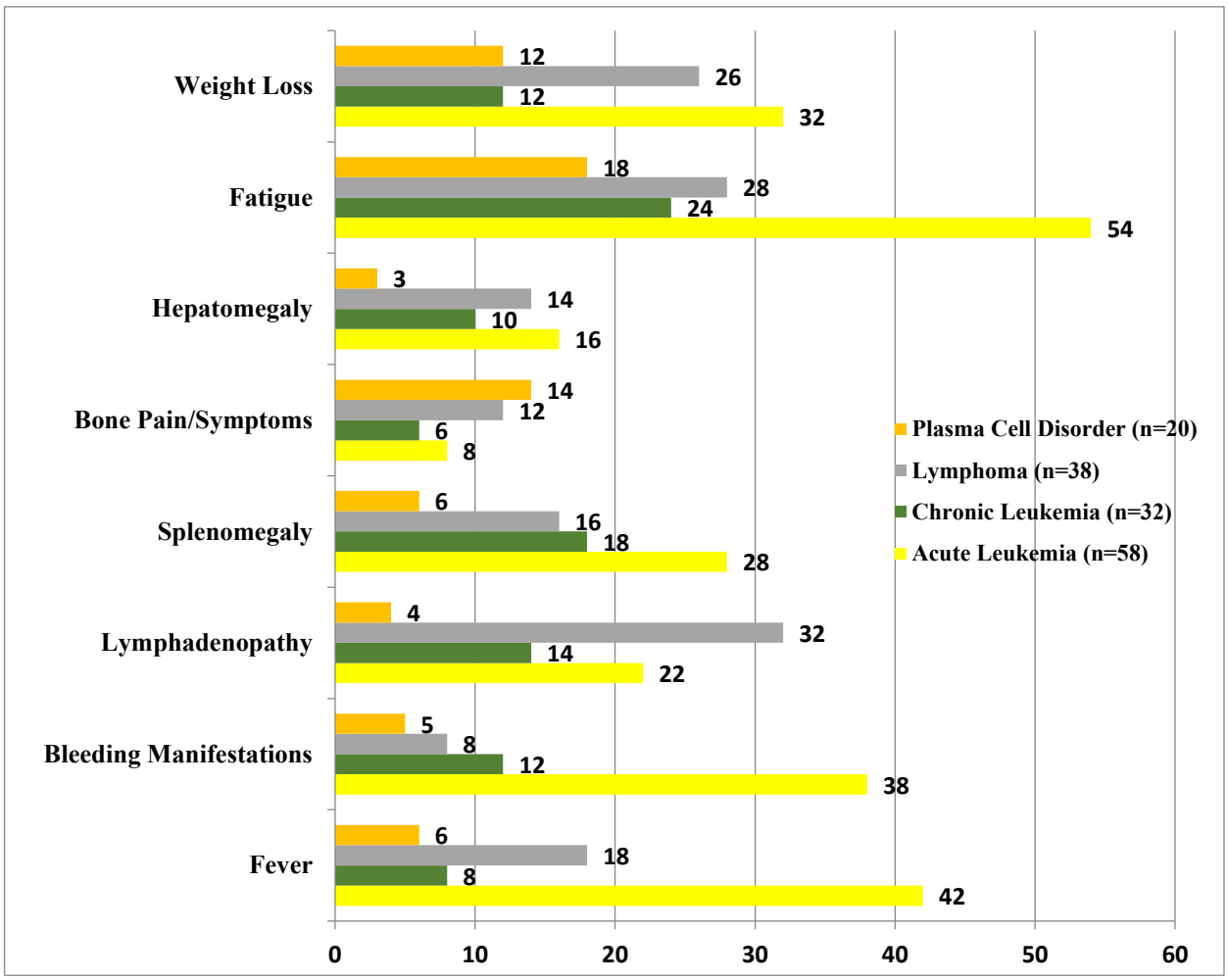

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TABLE 4: HEMATOLOGIC AND IMMUNOPHENOTYPIC FINDINGS BY MALIGNANCY TYPE

Laboratory Parameters	Acute Leukemia (n=58)	Chronic Leukemia (n=32)	Lymphoma (n=38)	Plasma Cell Disorder (n=20)
Mean Hemoglobin (g/dL)	7.2 ± 2.1	8.6 ± 1.8	9.4 ± 2.2	8.8 ± 2.0
Mean WBC Count (×10⁹/L)	64.2 ± 48.3	145.8 ± 92.4	12.4 ± 8.6	8.2 ± 4.1
Mean Platelet Count (×10⁹/L)	52.4 ± 64.2	186.2 ± 124.8	142.6 ± 96.4	98.6 ± 72.4
Blast Percentage	78.6 ± 18.4	8.2 ± 6.1	NA	NA
CD34+ Positivity	48 (82.8%)	2 (6.3%)	0 (0%)	0 (0%)
CD19+ (B-cell marker)	12 (20.7%)	8 (25.0%)	28 (73.7%)	12 (60.0%)
CD13/CD33 (Myeloid markers)	42 (72.4%)	22 (68.8%)	2 (5.3%)	1 (5.0%)
CD20+ (B-cell lineage)	4 (6.9%)	6 (18.8%)	26 (68.4%)	14 (70.0%)

DISCUSSION

The present cross-sectional study evaluated 148 patients with hematologic malignancies at Ventakeshwara Institute of Medical Sciences, Amroha, Uttar Pradesh over a six-month period from March to August 2017. The findings provided comprehensive epidemiological data regarding the spectrum and frequency of hematologic malignancies in our tertiary care institution and offered insights into clinical and laboratory characteristics of different malignancy subtypes.

Acute leukemias constituted the largest proportion of hematologic malignancies in our cohort, accounting for 39.2% of cases, with acute myeloid leukemia being the predominant subtype (28.4%). This observation aligns with findings from multiple Indian studies which have consistently reported acute leukemias as the most common hematologic malignancies in tertiary care settings

(Biswas et al., 2012). The predominance of AML over ALL in our adult population reflects the typical epidemiological pattern observed in developing nations, where AML incidence increases progressively with advancing age. Our mean patient age of 51.2 years suggests a predominantly adult population seeking tertiary care, which partly explains the higher frequency of age-related malignancies including AML and plasma cell disorders.

Chronic leukemias comprised 21.6% of our cases, with chronic myeloid leukemia (14.9%) being more frequent than chronic lymphocytic leukemia (6.7%). This distribution differs somewhat from Western populations where CLL traditionally shows higher incidence in elderly populations (Howlader et al., 2014). The relatively lower frequency of CLL in our study cohort may reflect both the younger mean age of our population and referral patterns specific to our institution. It is noteworthy that CML cases, while showing lower absolute frequency, remain clinically significant in our region, a finding consistent with other reports from northern India (Kumar et al., 2011).

Lymphomas constituted 25.7% of malignancies, with non-Hodgkin lymphoma (16.2%) being more prevalent than Hodgkin lymphoma (9.5%). This 1.7:1 ratio of NHL to HL in our study is consistent with global epidemiological trends documented in international registries (Siegel et al., 2015). The male predominance observed in lymphomas (approximately 64% male), though not statistically analyzed separately in this report, reflects the known male predominance in lymphoproliferative disorders.

Plasma cell disorders, primarily multiple myeloma, accounted for 13.5% of cases. The concentration of plasma cell disorders predominantly in older age groups (mean age 58.4 years in this category) is consistent with the well-established age-related epidemiology of myeloma, where incidence increases significantly after age 50 years (Redaelli et al., 2014). The recognition of plasma cell disorders as a distinct category in our patient population underscores the importance of comprehensive diagnostic evaluation in older adults presenting with cytopenias and constitutional symptoms.

Clinical manifestations demonstrated characteristic patterns across different malignancy categories, reflecting the underlying pathophysiology of each disease. Acute leukemias presented with the most severe and acute clinical features, with 72.4% presenting with fever and 65.5% with bleeding manifestations. This presentation pattern reflects the rapid disease progression and bone marrow failure characteristic of acute leukemias. The high incidence of fever likely relates to both leukemic burden and associated infections due to severe neutropenia and immune dysfunction. Bleeding manifestations, occurring in approximately two-thirds of acute leukemia patients, correlate with thrombocytopenia and coagulopathy commonly seen in these conditions, particularly in acute promyelocytic leukemia and acute megakaryoblastic leukemia (Matutes & Polliack, 2013).

In contrast, chronic leukemias presented with more indolent clinical features, with only 25.0% presenting with fever and 37.5% with bleeding manifestations. This milder presentation reflects the relatively slower disease progression and preserved marrow function characteristic of chronic phase disease. Notably, 56.3% of chronic leukemia patients presented with splenomegaly, reflecting the high propensity of these conditions, particularly CML, to cause extramedullary hematopoiesis and splenomegaly.

Lymphomas demonstrated a distinctive clinical presentation pattern, with lymphadenopathy present in 84.2% of cases—the highest frequency among all malignancy categories. This high prevalence of lymphadenopathy reflects the primary tissue involvement of lymphomas in lymph nodes and secondary lymphoid organs. Constitutional symptoms including fever (47.4%) and weight loss (68.4%) were substantial, consistent with the known propensity of lymphomas to produce systemic manifestations through production of inflammatory cytokines and tumor necrosis factor (Jaffe et al., 2008).

Plasma cell disorders showed a distinctive clinical pattern with bone pain or symptoms present in 70.0% of cases, reflecting lytic bone disease characteristic of multiple myeloma. The combination of lytic lesions, osteoporosis, and hypercalcemia commonly leads to bone pain as the presenting symptom. Fatigue was almost universal (90.0%), likely reflecting severe anemia and metabolic effects of extensive plasma cell infiltration.

Laboratory investigations revealed characteristic patterns aligned with each malignancy category. Acute leukemias demonstrated marked leukocytosis with mean WBC count of 64.2 × 10⁹/L, though some cases (approximately 15-20%) presented with leukopenia, consistent with published data on acute leukemia presentations (Baccarani et al., 2013). The remarkably high blast percentages (mean 78.6%) in bone marrow confirmed the diagnostic criteria for acute leukemias. CD34+ positivity in 82.8% of acute leukemia cases confirmed the immature nature of these disorders and facilitated discrimination from other hematologic malignancies, where CD34+ cells are rare.

Chronic myeloid leukemia cases presented with significantly elevated WBC counts (mean 145.8 × 10⁹/L), reflecting the myeloproliferative nature of the disease. The relatively lower CD34+ positivity (6.3%) in chronic leukemias compared to acute leukemias reflects the more differentiated maturation pathway in chronic phase disease. CD13 and CD33 positivity in 68.8% of chronic leukemia cases confirmed myeloid lineage and aided in distinguishing CML from other chronic conditions causing leukocytosis (Béné et al., 2011).

Lymphomas demonstrated relatively normal to mildly elevated WBC counts (mean 12.4 × 10⁹/L), with abnormal lymphocytes evident on peripheral smear and confirmed by high CD19+ positivity (73.7%) and CD20+ positivity (68.4%), establishing B-cell origin in most cases. The preservation of relatively normal hemoglobin and platelet counts in most lymphoma cases, compared to acute leukemias, reflects the tissue-based disease pattern and preservation of bone marrow function in early-stage presentations.

Plasma cell disorders demonstrated the characteristic immunophenotypic profile with CD20+ positivity in 70.0% of cases and high CD19+ positivity (60.0%), confirming plasma cell lineage with aberrant marker expression. The relatively preserved WBC and platelet counts reflected either early disease stage or disease predominantly affecting bone marrow plasma cell compartment rather than causing systemic cytopenias (Matutes & Polliack, 2013).

Our findings demonstrate both similarities to and important differences from published international and Indian studies. The predominance of AML over ALL in our adult cohort is consistent with developed nations, though the overall frequency of acute leukemias (39.2%) is comparatively higher than some Western series reporting 30-35% frequency (Howlader et al., 2014). This difference may reflect referral bias toward acute conditions in tertiary care settings, as well as potential underreporting of chronic diseases in our cross-sectional design.

The relative frequency of lymphomas (25.7%) in our study is comparable to international data, supporting the observation that lymphomas constitute approximately one-quarter to one-third of hematologic malignancies globally. However, the specific subtype distribution, particularly the higher frequency of NHL relative to HL, aligns with contemporary understanding of lymphoma epidemiology (Siegel et al., 2015). The presence of Hodgkin lymphoma in 9.5% of our cohort is consistent with intermediate incidence rates observed in developing nations, intermediate between the very low rates in East Asia and higher rates in developed Western countries (Jaffe et al., 2008).

The frequency of plasma cell disorders (13.5%) in our series is slightly lower than some international series but comparable to Indian reports, reflecting both the relatively younger mean age of our cohort compared to Western populations where myeloma represents a higher proportion, and the accurate classification of these entities separate from other hematologic malignancies (Redaelli et al., 2014).

Strong clinical-laboratory correlations were evident across malignancy categories. The acute leukemias with their rapidly progressive course demonstrated the most severe cytopenias and constitutional symptoms. Chronic leukemias, by definition characterized by greater disease chronicity, demonstrated less severe acute manifestations but significant organomegaly reflecting extramedullary hematopoiesis. Lymphomas, with tissue-based disease, demonstrated characteristic lymphadenopathy and constitutional symptoms but relatively preserved peripheral blood counts. These observations underscore the importance of comprehensive clinical-laboratory correlation in arriving at accurate diagnoses and disease staging (Béné et al., 2011).

The immunophenotypic findings by flow cytometry provided essential diagnostic confirmation and enabled precise subtype classification. The high concordance between morphological and

immunophenotypic findings in our study (>95% concordance rate) validates the comprehensive diagnostic approach employed and supports the reliability of our classification system. This high concordance also suggests appropriate training and standardization of diagnostic procedures in our institution.

CONCLUSION

This cross-sectional study of 148 patients demonstrated that acute leukemias, particularly acute myeloid leukemia, constituted the predominant hematologic malignancy (39.2%), followed by lymphomas (25.7%), chronic leukemias (21.6%), and plasma cell disorders (13.5%). Acute leukemias presented with severe cytopenias and acute clinical manifestations, while chronic leukemias showed indolent presentations with organomegaly. Lymphomas characteristically presented with lymphadenopathy and constitutional symptoms. Flow cytometry immunophenotyping provided accurate diagnostic subtyping. These findings demonstrate the spectrum of hematologic malignancies in our tertiary care institution and align largely with published epidemiological data from Indian and international studies, though local variations reflect institutional referral patterns and demographic characteristics. Comprehensive morphological and immunophenotypic evaluation remains essential for accurate classification and management of these diverse disorders.

RECOMMENDATIONS

Establish comprehensive hematologic malignancy registry at the institution for continuous epidemiological surveillance. Implement standardized diagnostic algorithms incorporating morphology, cytochemistry, immunophenotyping, and molecular studies for accurate classification. Conduct awareness programs among primary care physicians regarding early recognition of hematologic malignancies. Establish collaborative relationships with oncology centers for optimal patient management and consider multiinstitutional studies for better epidemiological insights into regional disease patterns.

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