Innovations

To Assess the Relationship between Anemia and Hematological Malignancies: An Observational Study

[1] Dr. Mandeep Kaur; [2] Dr. Suby singh; [3] Dr. Gunveen Kaur; [4] Dr. Namita Katyal

[1]Associate Professor, Dept of Oral Pathology & Microbiology, Indira Gandhi Govt Dental College, Jammu, India

[2] Assistant Professor, Dept of Pathology, State Cancer Institute, Jammu

[3] Senior lecturer, Dept of Oral Pathology, IDS, Sehora, Jammu, India

[4] Professor, Dept of Orthodontics, R.K.D.F Dental College and research centre, Bhopal, India

Corresponding Author: **Dr. Mandeep Kaur**

Abstract

Introduction*: Anaemia is a reduction in the total erythrocyte mass in the peripheral circulation. The functional outcome of anaemia is a decrease in the oxygen-carrying capacity of blood that leads to tissue hypoxia.* ***Aim****: The main aim of this study is to investigate the types of anemia in patients with hematological malignancies.* ***Materials & Methods****: A total of 29 patients diagnosed with hematological malignancy were taken for the study. Relevant patient information were procured from the records including demographic data, complete blood count (CBC) findings at presentation, blood films, bone marrow slides. Furthermore, erythrocyte sedimentation rate, reticulocytes count Coombs test, iron status, prothrombin time (PT), and activated partial thromboplastin time (APTT) were also evaluated.* ***Results****: It was found that the most prevalent hematological malignancy was chronic lymphocytic leukemia and the less prevalent form was multiple myeloma. It was also observed that normocytic anemia was most common and macrocytic anemia was least.* ***Conclusion:*** *The present study showed that normocytic anemia was most prevalent in hematological malignancies.*

Keywords*: Anaemia, normocytic anemia, multiple myeloma, leukemia, lymphoma*

Introduction

Anemia is the most common haematological disorder globally. It can be a sign of reduced haematopoiesis, increased destruction (haemolysis), and increased requirement of erythrocytes.

Aetiologic classification of the anaemia

Loss of Blood

Acute: Trauma

Chronic: Gastrointestinal tract lesions, gynaecological causes, tumours

Decreased Red Cell Production

Nutritional deficiency - Iron, vitamin B12, folate

Inflammation mediated - Iron deficiency anaemia of chronic disease

Erythropoietin deficiency - Renal disease

Immune-mediated - Aplastic anaemia

Bone marrow infiltration - Primary haematopoietic neoplasms, metastatic neoplasms

Endocrine failures - Thyroid, pituitary

Increased Red Cell Destruction

- Membrane alterations (genetic) - Hereditary elliptocytosis, hereditary spherocytosis
- Membrane alterations (acquired) - Hypophosphataemia, paroxysmal nocturnal haemoglobinuria
- Enzyme deficiencies- G6PD, pyruvate kinase, hexokinase
- Haemoglobin abnormalities - Thalassaemia syndromes sickle-cell disease, haemoglobinopathies
- Immunologic abnormalities- Haemolytic disease of newborn, transfusion reactions, drug-induced reactions
- Mechanical trauma - Disseminated intravascular coagulation, throm- botic thrombocytopenic purpura, defective cardiac valves, repeated physical trauma

Infections of red cells Toxic /chemical injury - Malaria Snake venom, lead poisoning Splenic Sequestration - Reticuloendothelial hyperactivity with splenomegaly[1].

Hematologic malignancies are cancers that begin in blood-forming tissue, e.g., the bone marrow, or in the cells of the immune system. Hematological malignancies have historically been a pioneer among cancers in the use of genetic analysis, particularly for diagnosis and classification. Genetic characterization and changes in genome organization are crucial in the clinical evaluation of almost every form of hematological malignancy. Genomic analysis and molecular diagnosis are important diagnostic tools in the diagnosis and management of acute leukemias, chronic myeloid neoplasms, B- and T-/natural killer (NK)-cell lymphomas, as well as multiple myeloma[2,3].

Changes that occur with genomic mutations are used in the classification and subgroups of hematological malignancies. Accordingly, hematologic malignancies are generally grouped into 3 main groups such as leukemia, lymphoma and multiple myeloma. In addition, it can be categorized into

different subgroups, such as acute leukemias, chronic leukemias, myelodysplastic syndromes (MDS), myeloproliferative neoplasms (MPNs), non-Hodgkin lymphomas, and classic Hodgkin lymphoma[4].

Materials & Methods

A total of 29 patients with hematological malignancies from state cancer institute, Bakshi Nagar were procured from August 2024 to May 2025. Diagnosis was made on the basis of history, clinical presentation, physical appearance, complete blood count, blood films, bone marrow biopsies. ESR, reticulocyte count, PT, APTT, Iron status investigations were also done and recorded.

Cases included were

a. Acute lymphocytic leukemia (ALL) - 4
b. Acute Myeloid leukemia (AML) -5
c. Chronic lymphocytic leukemia (CLL) -8
d. Chronic Myeloid leukemia (CML) -4
e. Hodgkins lymphoma (HL) -3
f. Non Hodgkins lymphoma (NHL) -2
g. Multiple myeloma (MM) -3

Statistical Analysis

The data was collected, compiled, and analyzed using student 't' test and 'p' value of <0.05 was considered to be statistically significant.

Results

It was observed that chronic lymphocytic leukemia (CLL) was the most prevelant malignancy while multiple myeloma was the least form. (Table 1)

Table 1. Frequency distribution of different types of Hematological malignancies

Hematological malignancies	No. of subjects
Leukemias	
ALL	4
AML	5
CLL	8
CML	4
Lymphomas	
HL	3
NHL	2
Multiple myeloma	3

- The mean age and standard deviation of patients with ALL and AML was 10.5 years ±3.696 & 32.6 years ±14.293 which was considered to be statistically significant.
- The mean age and standard deviation of patients with CLL and CML was 55.5 years ±8.717 & 40 years ±12.436 which was considered to be statistically significant.
- The mean age and standard deviation of patients with HL and NHL was 28.6 years ±5.686 & 68.5 years ±2.121 which was considered to be statistically significant.
- However the mean age and standard deviation of patients with MM was 57.6 years ±3.214 respectively. (Table 2)

Table 2: Distribution and comparison of hematological malignancies according to Age

Groups	N=29	Mean	SD	p-Value
ALL	4	10.5	±3.696	0.017 (Significant)
AML	5	32.6	±14.293	
CLL	8	55.5	±8.717	0.029 (Significant)
CML	4	40	±12.436	
HL	3	28.6	±5.686	0.002 (Significant)
NHL	2	68.5	±2.121	
MM	3	57.6	±3.214	

Mean and SD of Hb status in ALL and AML was 8.6 ±1.108 and 8.2 ±1.643. Mean and SD of Hb status in CLL and CML was 8.7 ±1.488 and 8.2 ±0.957. Mean and SD of Hb status in HL and NHL was 7.6 ±2.081 and 8.2 ±0.353. However these values were not statistically significant. Mean and SD of Hb status in MM was 9.1 ±1.258. (Table 3)

Table 3: Haemoglobin status in hematological malignancies

Group	Mean	SD	p-Value
ALL	8.6	±1.108	0.690 (Not Significant)
AML	8.2	±1.643	
CLL	8.7	±1.488	0.559 (Not Significant)
CML	8.2	±0.957	
HL	7.6	±2.081	0.705 (Not Significant)
NHL	8.2	±0.353	
MM	9.1	±1.258	

Mean and SD of patients with hematological malignancies having microcytic, normocytic and macrocytic anemias was 69 ±4.472, 93.8 ±4.973 and 114 ±4.898 which was considered to be highly statistically significant. (Table 4)

Table 4: Distribution and comparison of MCV

Mean corpuscular volume	n =29	Mean	SD	p-Value
Microcytic	7	69	±4.472	0.0001(Significant)
Normocytic	18	93.8	±4.973	
Microcytic		69	±4.472	0.0001(Significant)
Macrocytic	4	114	±4.898	
Normocytic		93.8	±4.973	0.0001(Significant)
Macrocytic		114	±4.898	

Male predominance was observed in all the cases with M: F ratio being 0.7:0.2. (Table 5)

Table 5. Distribution frequency according to gender

Gender	ALL	AML	CLL	CML	HL	NHL	MM	Total	Percentage
Male	3	3	5	3	2	2	3	21	72.4
Female	1	2	3	1	1	0	0	8	27.5

Discussion

Anemia is a common complication in patients with hematologic malignancies, and is caused by a variety of mechanisms, including neoplastic cell infiltration into the bone marrow, hemolysis, nutritional deficiencies, and defects in erythropoiesis as a result of the disease itself or cytotoxic therapy. Anemia results in fatigue, exhaustion, dizziness, headache, dyspnea, and decreased motivation, seriously affecting a patient's quality of life. Since anemia is so prevalent in hematologic malignancy patients, its treatment must be an integral part of disease management, to improve quality of life and to possibly increase potential survival[5].

The age distribution of the population can provide evidence for primary prevention by reflecting the health burden of different age groups. People over the age of 70 are at high risk of developing hematologic malignancies, about 80% of all age groups. In the present study age range was between 28 to 68 years in all hematological malignancies consistent with previous studies[6,7]. In terms of gender, the incidence and death of hematologic malignancies are generally higher in males than in females globally as seen in our study[8].

Lymphomas represent one of the commonest malignancies. There has been an increase in non hodgkin lymphoma (NHL) cases in past few decades and among B cell lymphomas diffuse large B cell lymphoma (DLBCL) is the commonest type.

Anemia is frequently encountered in lymphoma patients and even observed before patients are started on chemotherapy and also in the absence of bone marrow involvement. It is a presenting feature in approximately 40% of patients with Hodgkin's lymphoma (HL) and is considered an important adverse prognostic factor for outcomes of therapy especially in the background of bone marrow involvement which is yet another factor associated with poor prognosis[9].

There are multiple factors responsible for anemia in patients with lymphoproliferative disorders, including anemia of chronic disease, iron deficiency anemia, nutritional deficiencies, autoimmune hemolytic anemia, marrow infiltration and blood loss. The pathogenesis behind anemia of chronic disease is likely bone marrow erythroid hypoplasia, shortened red cell survival, decreased erythropoietin production and high inflammatory cytokine production by lymphoma cells. Several inflammatory mediators have been `identified such as interleukin 1, gamma interferon and tumor necrosis factor that inhibit erythropoiesis. Abnormal iron utilization, inappropriately low serum erythropoietin levels and decreased marrow response to erythropoietin are also responsible for anemia in these patients[10].

Multiple myeloma (MM) is characterized by bone destruction, anaemia, and renal and immunological impairment. These complications may lead to a severe reduction in the quality of life of myeloma patients and may shorten their life expectancy. Anaemia is the most common complication of myeloma patients at diagnosis and in almost all patients with uncontrolled disease. Given the known adverse impact of multiple myeloma on physical functioning and quality-of-life variables, including fatigue and cognitive function, managing anaemia should be an integral part of myeloma patient care. Elucidating the mechanism underlying anaemia and developing an effective treatment are critical for improving the quality of life of MM patients. The most frequent underlying pathophysiological conditions reported previously in myeloma-related anaemia are aberrant iron metabolism, renal impairment and anaemia of chronic disease[11,12].

Conclusion

Hematologic malignancies are among the most common cancers, and understanding their incidence and death is crucial for targeting prevention, clinical practice improvement, and research resources appropriately. The anemia associated with multiple myeloma is caused by inadequate erythropoietin levels consequent to renal impairment and the effect of inflammatory cytokines. The degree of anemia can have prognostic importance, as noted with chronic lymphocytic leukemia. The burden of hematologic malignancies is generally higher in men, and this gender gap decreases after peaking at a given age. The shorter duration of the study resulted in a smaller sample size. Subsequent studies must be undertaken for a longer duration to validate these findings.

References

1. *William Wesson, Vincent L Galate, Douglas Sborov, Brain Mcclune. Characteristics of clinical trials for haematological malignancies from 2015 to 2020: A systematic review. European Journal of cancer Feb 2022;Vol 167:152-160.*
2. *Pulte, D. · Jansen, L. · Brenner, H.Changes in long term survival after diagnosis with common hematologic malignancies in the early 21st century Blood Cancer J. 2020; 10:56.*
3. *Littlewood T, Mandelli F. The effects of anemia in hematologic malignancies: more than a symptom. Semin Oncol. 2002 Jun;29(3 Suppl 8):40-4.*
4. *Ghanem S, Gonsky J. Recurrent anemia in a patient with chronic lymphocytic leukemia. Cleve Clin J Med. 2022;89(2):91-8.*
5. *Nwannadi IA, Alao OO, Bazuaye GN, Halim HK, Omoti CE. The Epidemiology of Haematological Malignancies at the University of Benin Teaching Hospital: A Ten-Year Retrospective Study. Int J Epidemiol. 2010;9:1-6.*
6. *Maqsood Shafaq, Badar Farhana, Hameed Abdul. Characteristics and Outcomes of Patients with Hematological Malignancies Admitted for Intensive Care - a Single Centre Experience. Asian Pac J Cancer Prev. ;18:1833-7.*
7. *Rodriguez-Abreu D, Bordoni A, Zucca E. Epidemiology of Haematological Malignancies. Ann Onco. 2007;18:13-8.*
8. *Moullet I, Salles G, Ketterer N, Dumontet C, Bouafia F, Neidhart-Berard EM, et al. Frequency and significance of anemia in non-Hodgkin's lymphoma patients. Ann Oncol. 1998;9(10):1109–1115.*
9. *Mamus SW, Beck-Schroeder S, Zanjani ED. Suppression of normal human erythropoiesis by gamma interferon in vitro. Role of monocytes and T lymphocytes. J Clin Invest. 1985;75(5):1496–1503.*
10. *Kumar, S. K. et al. Multiple myeloma. Nat. Rev. Dis. Primers. 2017; 3 ;17046.*
11. *Kawano, Y., Roccaro, A. M., Ghobrial, I. M. & Azzi, J. Multiple myeloma and the immune microenvironment. Curr. Cancer Drug Targets. 2017;17(9): 806–818.*