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Assessment Of Anemia and Thrombocytopenia in Patients with Lymphomas Before and After Chemotherapy

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Name of Author:
Dr. Vijay Kumar Bhargava[1], Dr. Harsh Sahu[2], Dr. Shaunak Valame[3], Dr. Kanchan Singh[4], Dr. Neelam Pandey[5]

Affiliation:
[1]Head of Department and Senior Consultant, Department of Medical Oncology, Jawaharlal Nehru Cancer Hospital and Research Centre, Bhopal, Madhya Pradesh, India
[2]Consultant, Department of Medical Oncology, Jawaharlal Nehru Cancer Hospital and Research Centre, Bhopal, Madhya Pradesh, India
[3]Consultant, Department of Medical Oncology, Jawaharlal Nehru Cancer Hospital & Research Centre, Bhopal, Madhya Pradesh, India
[4]DrNB 3rd Year Resident, Department of Medical Oncology, Jawaharlal Nehru Cancer Hospital and Research Centre, Bhopal, Madhya Pradesh, India
[5]DrNB 2nd Year Resident, Department of Medical Oncology, Jawaharlal Nehru Cancer Hospital and Research Centre, Bhopal, Madhya Pradesh, India

Corresponding Author:
Dr Vijay Kumar Bhargava
Email: *drvijayoncologist@gmail.com*

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Abstract: ***Background***: Treatment of lymphomas is frequently complicated by cytopenias. Among these, anemia and thrombocytopenia significantly affect treatment tolerance, quality of life, and prognosis. The present study aimed to assess the extent and severity of anemia and thrombocytopenia in patients with lymphomas before and after chemotherapy. ***Material and Methods***: An analytical cross-sectional study was conducted on 123 patients diagnosed with lymphomas in a tertiary care hospital. Baseline demographic and clinical data were recorded. Venous blood samples were obtained before the initiation of chemotherapy and again 14 days after completion of the first chemotherapy cycle. Hemoglobin and platelet counts were analyzed using an automated hematology analyzer. Data were evaluated using paired t-test, and a p-value <0.05 was considered statistically significant. ***Results***: The mean age of participants was 46.3 ± 12.7 years, with a male-to-female ratio of 1.4:1. The predominant malignancy was high grade B cell lymphoma (43.1%), followed by Hodgkins lymphoma (25.2%), low grade B cell lymphoma (21.1%), and T cell lymphoma (10.6%). Mean hemoglobin levels decreased significantly from 10.40 ± 1.39 g/dL to 9.17 ± 1.50 g/dL (p< 0.001). Mean platelet counts dropped from 182.12 ± 44.80 ×10³/µL to 121.62 ± 55.55 ×10³/µL (p< 0.001). Post-chemotherapy, the proportion of patients with moderate to severe anemia increased from 43.1% to 62.6%, and those with moderate to severe thrombocytopenia rose from 14.6% to 41.4%. ***Conclusion***: Chemotherapy significantly worsens anemia and thrombocytopenia in patients with hematological malignancies. Regular hematological monitoring and timely supportive interventions are crucial to minimize treatment interruptions and improve patient outcomes.

Keywords: Anemia; Thrombocytopenia; Chemotherapy; Myelosuppression.

INTRODUCTION

Lymphomas frequently cause baseline cytopenias due to bone marrow infiltration, disease-associated inflammation, nutritional deficiencies, and immune-

mediated mechanisms; these processes commonly manifest as anemia and thrombocytopenia at presentation. Chemotherapy compounds this problem by producing dose-dependent myelosuppression that reduces erythropoiesis and platelet production, thereby increasing the frequency and severity of anemia and thrombocytopenia during treatment [1,2]. Chemotherapy-induced anemia (CIA) is among the most common hematologic complications in patients receiving anticancer therapy and contributes substantially to fatigue, reduced exercise tolerance, and impaired quality of life; it may also necessitate transfusion or dose modification that can compromise oncologic treatment intensity. The pathogenesis of CIA is multifactorial and includes direct marrow toxicity from cytotoxic agents, tumor-related bone marrow involvement, inflammation-mediated iron sequestration, and impaired erythropoietin response [1,3]. Clinical practice guidelines and contemporary reviews emphasize the need for routine hemoglobin assessment and individualized supportive care, such as iron supplementation, erythropoiesis-stimulating agents, or transfusion, when indicated [3,4].

Thrombocytopenia related to cancer and its treatment is similarly clinically significant. Observational data indicate that patients with hematologic malignancies including lymphomas experience higher rates of treatment-associated thrombocytopenia than patients with solid tumors; for example, in a large real-world cohort the three-month cumulative incidence of any thrombocytopenia after chemotherapy initiation was substantially greater in hematologic malignancies compared with solid tumors [5]. Chemotherapy-induced thrombocytopenia (CIT) heightens bleeding risk and frequently forces chemotherapy dose reductions, delays, or omissions. Management options range from platelet transfusion for bleeding or very low counts to dose adjustments and, in selected contexts, use of thrombopoietic agents to sustain platelet production [2,4].

Beyond immediate clinical consequences, multilineage myelosuppression (anemia, thrombocytopenia and neutropenia) imposes measurable burdens on patients and health systems: increased supportive-care interventions, higher rates of hospitalization, and worse treatment persistence and relative dose intensity have been reported in community and trial populations [6]. These observations underscore the clinical importance of monitoring blood counts before and after chemotherapy and of documenting patterns of cytopenia in specific patient populations to guide prophylactic and therapeutic strategies.

Despite recognition of these issues, data quantifying the magnitude of hemoglobin and platelet decline specifically in patients with lymphomas—evaluated pre-treatment and shortly after an initial chemotherapy cycle—remain variable across settings. The present study therefore aimed to quantify changes in hemoglobin concentration and platelet count before and after chemotherapy in a hospital-based cohort of patients with lymphomas, and to characterize shifts in the severity distribution of anemia and thrombocytopenia following treatment.

MATERIALS AND METHODS

Study Design and Setting: This analytical cross-sectional study was conducted at a tertiary care teaching hospital in India. The study aimed to evaluate the hematological changes—specifically anemia and thrombocytopenia—in patients diagnosed with lymphomas, both prior to and following chemotherapy administration.

Study Population and Sample Size: A total of 123 patients with confirmed lymphomas were included in the study. The sample size was calculated based on an expected prevalence of anemia of approximately 80% among such patients, a confidence level of 95%, and a margin of error of 8%. Patients were selected using a convenience sampling technique from those attending the hematology outpatient and inpatient services during the study period.

Inclusion Criteria

- Patients aged ≥18 years with a confirmed diagnosis of lymphoma
- Individuals scheduled to receive at least one cycle of standard chemotherapy.
- Patients who provided written informed consent for participation.

Exclusion Criteria

- Patients with pre-existing nutritional anemia unrelated to malignancy.
- Those with chronic renal failure, hepatic dysfunction, or other systemic illnesses influencing hematological parameters.
- Patients who had received blood transfusion within 14 days prior to baseline sampling.

Data Collection Procedure: Baseline demographic data, clinical history, and type of lymphoma were recorded. Venous blood samples were collected from each participant before the initiation of chemotherapy (pre-treatment phase) and 14 days after the completion of the first chemotherapy cycle (post-treatment phase).

Laboratory Investigations: Blood samples were analyzed using an automated hematology analyzer.

The following hematological parameters were recorded:

- Hemoglobin concentration (g/dL)
- Red blood cell count ($\times 10^6/\mu L$)
- Hematocrit (%)
- Platelet count ($\times 10^3/\mu L$)

Peripheral blood smears were examined for morphological evaluation when required. The severity of anemia was graded according to World Health Organization (WHO) criteria [7], while thrombocytopenia was classified as mild (100–150 $\times 10^3/\mu L$), moderate (50–99 $\times 10^3/\mu L$), or severe (<50 $\times 10^3/\mu L$).

Data Management and Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and clinical variables. Quantitative data were expressed as mean ± standard deviation (SD). The paired t-test was applied to compare pre- and post-chemotherapy hemoglobin and platelet levels. A *p*-value of <0.05 was considered statistically significant.

RESULTS

A total of 123 patients diagnosed with lymphoma were included in the study. The mean age of the study participants was 46.3 ± 12.7 years, with a slight male predominance (57.7% males, 42.3% females). The most common lymphoma encountered was high grade B cell non hogdkins lymphoma (43.1%), followed by hogdkins lymphoma (25.2%), low grade B cell non hogdkins lymphoma (21.1%), and T cell lymphoma (10.6%). The majority of patients (68.3%) had an Eastern Cooperative Oncology Group (ECOG) performance status of 0–1 at baseline (Table 1).

Mean baseline hemoglobin concentration was 10.40 ± 1.39 g/dL, which decreased significantly to 9.17 ± 1.50 g/dL following chemotherapy ($p < 0.001$). Similarly, mean platelet count declined from 182.12 ± 44.80 $\times 10^3/\mu L$ before chemotherapy to 121.62 ± 55.55 $\times 10^3/\mu L$ after treatment, indicating a statistically significant reduction ($p < 0.001$) (Table 2).

Prior to chemotherapy, 17.9% of patients had normal hemoglobin levels, while 82.1% exhibited varying degrees of anemia. The majority presented with mild (39.0%) or moderate (30.9%) anemia. Post-chemotherapy assessment demonstrated a notable shift toward greater severity: severe anemia increased from 12.2% to 20.3%, and moderate anemia rose to 42.3%, while the proportion of non-anemic patients decreased to 8.1% (Table 3). This indicates a clear trend of worsening anemia following chemotherapy exposure.

A comparable pattern was observed for platelet counts. Before chemotherapy, 63.4% of patients maintained normal platelet levels, and 3.2% had severe thrombocytopenia. Following chemotherapy, the prevalence of moderate (26.8%) and severe (14.6%) thrombocytopenia increased substantially, with only 32.5% of patients retaining normal platelet counts (Table 4).

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n = 123)

Variable	Category	Number (n)	Percentage (%)
Age (years)	Mean ± SD	46.3 ± 12.7	—
Gender	Male	71	57.7
	Female	52	42.3
Type of Lymphoma	High grade B cell lymphoma	53	43.1
	Hogdkins lymphoma	31	25.2
	Low grade B cell lymphoma	26	21.1
	T cell lymphoma	13	10.6
Baseline Performance Status (ECOG)	0–1	84	68.3
	≥2	39	31.7

Table 2: Comparison of Hemoglobin and Platelet Count Before and After Chemotherapy

Parameter	Pre-Chemotherapy (Mean ± SD)	Post-Chemotherapy (Mean ± SD)	p-value
Hemoglobin (g/dL)	10.40 ± 1.39	9.17 ± 1.50	<0.01
Platelet count ($\times 10^3/\mu L$)	182.12 ± 44.80	121.62 ± 55.55	<0.01

Table 3: Distribution of Anemia Severity Before and After Chemotherapy

Anemia Grade (WHO criteria)	Pre-Chemotherapy n (%)	Post-Chemotherapy n (%)
No anemia (Hb ≥ 12 g/dL)	22 (17.9)	10 (8.1)
Mild (10–11.9 g/dL)	48 (39.0)	36 (29.3)
Moderate (8–9.9 g/dL)	38 (30.9)	52 (42.3)
Severe (<8 g/dL)	15 (12.2)	25 (20.3)
Total	**123 (100)**	**123 (100)**

Table 4: Distribution of Thrombocytopenia Severity Before and After Chemotherapy

Platelet Count Category (×10³/µL)	Pre-Chemotherapy n (%)	Post-Chemotherapy n (%)
Normal (≥150)	78 (63.4)	40 (32.5)
Mild (100–149)	27 (22.0)	32 (26.0)
Moderate (50–99)	14 (11.4)	33 (26.8)
Severe (<50)	4 (3.2)	18 (14.6)
Total	**123 (100)**	**123 (100)**

DISCUSSION

This hospital-based cohort of 123 patients with lymphomas demonstrated statistically and clinically meaningful declines in hemoglobin and platelet counts after a single cycle of chemotherapy. Mean hemoglobin fell from 10.40 ± 1.39 g/dL to 9.17 ± 1.50 g/dL, and mean platelet count declined from 182.12 ± 44.80 ×10³/µL to 121.62 ± 55.55 ×10³/µL. Correspondingly, the proportions of patients with moderate-to-severe anemia and moderate-to-severe thrombocytopenia increased notably after treatment. These findings align with contemporary observations that patients receiving cytotoxic regimens—especially those with primary hematologic disease—have a high baseline burden of anemia and are at elevated risk of further myelosuppression following chemotherapy [8].

The high baseline prevalence and the marked post-treatment worsening of anemia in our cohort echo recent epidemiologic analyses that report frequent and often progressive anemia among cancer patients receiving systemic therapy. A 2024 multicenter analysis found that a large majority of patients treated with chemotherapy develop anemia, with hematologic cancers among the groups at greatest risk, driven by marrow involvement, inflammatory iron sequestration, and treatment toxicities [8]. The magnitude of hemoglobin decline seen in our study (mean drop ~1.2 g/dL) is consistent with reports that cytotoxic regimens commonly produce measurable hemoglobin decreases within the first treatment cycle, and that this decline contributes substantially to symptoms, transfusion need, and potential modifications of planned therapy [9,10].

Management guidelines emphasize early identification and targeted treatment of cancer-related anemia. Practical consensus statements and clinical practice guidelines support systematic assessment of iron status and consideration of intravenous iron when iron deficiency (absolute or functional) is identified, and reserve erythropoiesis-stimulating agents for selected patients according to risk–benefit considerations and local regulations [10,11]. Our results—where substantial proportions of patients shifted into moderate or severe anemia categories after chemotherapy—underscore the importance of baseline iron evaluation and timely supportive interventions to reduce symptomatic burden and the likelihood of transfusion.

Thrombocytopenia increased markedly in our cohort following chemotherapy, with normal platelet counts falling from 63.4% at baseline to 32.5% post-treatment and severe thrombocytopenia rising from 3.2% to 14.6%. This pattern is concordant with literature indicating that chemotherapy-induced thrombocytopenia (CIT) is frequent in lymphomas and is a common cause of treatment delay, dose reduction and bleeding events[12]. Recent reviews and observational series have documented similar shifts in platelet distribution following chemotherapy and have highlighted the dual consequence of patient morbidity and disruptions to planned oncologic dosing [12,13].

Because suboptimal delivery of planned chemotherapy (dose reductions or delays) has been associated with worse disease control in several curative and palliative oncologic settings, measures that prevent or mitigate myelosuppression may have downstream effects on outcomes [14]. Our findings therefore signal a clinical imperative: pre-emptive

monitoring and appropriate supportive strategies are required to preserve dose intensity where clinically necessary. These strategies include transfusion support when indicated, correction of iron deficiency, judicious use of growth factors for neutropenia, and in selected scenarios, approaches to support platelet recovery.

Thrombopoietin receptor agonists (TPO-RAs) have emerged as a therapeutic option evaluated for CIT in recent years. Multicenter studies and systematic reviews suggest that agents such as romiplostim and eltrombopag can increase platelet counts and reduce transfusion requirements in selected populations, enabling continuation of chemotherapy in some cases; however, the evidence base is evolving and careful patient selection is needed given potential risks and variable efficacy across malignancy types and regimens [13,15]. Our data—showing a sizeable subset of patients developing moderate or severe thrombocytopenia—support consideration of clinical trials or guideline-based use of platelet-directed supportive therapies in centers where such options are available, particularly for patients in whom further dose reductions would materially compromise curative-intent regimens.

Limitations of the present study merit acknowledgement. The single-center design and convenience sampling restrict external generalizability; lymphoma subtypes and chemotherapy regimens are heterogeneous and could differentially affect cytopenia risk. We evaluated counts at baseline and at a single post-treatment timepoint (14 days after the first cycle), which captures early nadir for many regimens but does not characterize longitudinal recovery or cumulative effects over multiple cycles. Nevertheless, focusing on the first cycle provides valuable information about early myelotoxic impact and the need for prompt supportive planning.

CONCLUSION

The present study demonstrated a significant decline in both hemoglobin concentration and platelet count among patients with lymphomas following chemotherapy. Regular monitoring of complete blood counts before and after each chemotherapy cycle is therefore essential for early detection and management of cytopenias. Incorporating individualized supportive care strategies, including transfusion support, nutritional correction, and hematopoietic growth factor use when indicated, may help mitigate these adverse effects and improve overall treatment outcomes.

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