International Journal of Basic & Clinical Pharmacology
Sowmiya D et al. Int J Basic Clin Pharmacol. 2026 Mar;15(2):239-244
http://www.ijbcp.com
pISSN 2319-2003 | eISSN 2279-0780

DOI: https://dx.doi.org/10.18203/2319-2003.ijbcp20260337

Original Research Article

Retrospective study on chemotherapy–induced anaemia: incidence, treatment patterns and outcomes in a tertiary care hospital in South India

D. Sowmiya, B. Suthish, K. Bhuvaneswari*

Department of Pharmacology, PSG Institute of Medical Sciences and Research, Coimbatore, Tamil Nadu, India

Received: 02 January 2026
Accepted: 02 February 2026

***Correspondence:**
Dr. K. Bhuvaneswari,
Email: nandabhuvana@gmail.com

ABSTRACT

Background: Chemotherapy-induced anaemia (CIA) is a common complication in cancer patients and can negatively affect treatment continuity and quality of life. The severity of anaemia may vary depending on the chemotherapeutic drug class. This study aimed to evaluate the incidence, severity, management, and outcomes of CIA in a tertiary care hospital.
Methods: A retrospective observational study was conducted among 100 cancer patients who received chemotherapy between January 2024 and December 2024. Demographic data, cancer diagnosis, chemotherapy regimens, haemoglobin levels before and after chemotherapy, anaemia grading, management strategies, and outcomes were collected. Haemoglobin changes were analysed using paired t-test, and differences between drug classes were assessed using one-way ANOVA.
Results: Mean haemoglobin levels decreased significantly from 13.40±0.90 g/dl before chemotherapy to 9.49±1.47 g/dl after chemotherapy (mean reduction 3.91±1.65 g/dl; $p<0.001$). Grade 1 anaemia was observed in 52% of patients, grade 2 in 27%, grade 3 in 15%, and grade 4 in 6%. Haemoglobin reduction differed significantly among drug classes ($F=5.917$, $p=0.0001$), with greater reductions seen with alkylating agents, taxanes, and PD-1 receptor inhibitors. Iron therapy (40%) and blood transfusions (19%) were the most common management strategies. Clinical improvement was observed in 97% of patients.
Conclusions: Chemotherapy causes a significant reduction in haemoglobin levels, with variability across drug classes. Regular monitoring and appropriate management of anaemia are essential during chemotherapy.

Keywords: Anaemia, Chemotherapy, Haemoglobin, Antineoplastic agents, Blood transfusion

INTRODUCTION

Anaemia is one of the most common haematological complications observed in patients with cancer and represents a significant clinical challenge in oncology practice. It has been reported that approximately 30-50% of patients with solid tumours are anaemic at the time of diagnosis, with prevalence increasing substantially during the course of anticancer therapy and in advanced disease stages.[1-3]Among the various causes of cancer-associated anaemia, CIA is a major and potentially preventable contributor.

The pathogenesis of CIA is multifactorial. Cytotoxic chemotherapeutic agents directly suppress bone marrow erythropoiesis, reduce erythroid progenitor cell survival, and impair endogenous erythropoietin responsiveness.[4,5] Additional contributing mechanisms include chronic inflammation, functional and absolute iron deficiency mediated by hepcidin dysregulation, nutritional deficiencies, and cumulative chemotherapy exposure.[6-8]

The degree of haemoglobin decline may vary depending on the class of chemotherapeutic drugs used, with platinum compounds, taxanes, and alkylating agents being associated with a higher risk of clinically significant anaemia.[9,10]

Anaemia has important clinical consequences in cancer patients. Even mild-to-moderate reductions in haemoglobin levels can lead to fatigue, dyspnoea, reduced exercise tolerance, and impaired quality of life.[11] More severe anaemia may result in chemotherapy dose reductions, treatment delays, or premature discontinuation, which can adversely affect treatment efficacy and patient outcomes.[12] Therefore, early identification and appropriate management of CIA are essential to ensure optimal delivery of anticancer therapy.

Management strategies for CIA include iron supplementation, packed red blood cell transfusion, and erythropoiesis-stimulating agents, each of which carries specific benefits and limitations related to efficacy, safety, cost, and availability.[4,5] Real-world data suggest considerable variation in anaemia management practices across institutions, influenced by disease characteristics, treatment regimens, and resource constraints.[10,13] However, data describing the incidence, severity, and management of CIA in routine clinical practice, particularly in the Indian setting, remain limited.

Given the heterogeneity of chemotherapy regimens and patient profiles, institution-specific data are essential to better understand the burden of CIA and guide supportive care strategies.

This retrospective study was therefore undertaken to evaluate the incidence and severity of CIA, assess the impact of different chemotherapeutic drug classes on haemoglobin levels, analyse management patterns, and determine treatment outcomes among cancer patients treated at a tertiary care hospital in South India.

METHODS

Study design and setting

This was a retrospective observational study conducted in the oncology department of PSG institute of medical sciences and research (PSG IMSR), Coimbatore, Tamil Nadu, India.

Medical records of patients who received chemotherapy during a one-year period from January 2024 to December 2024 were reviewed.

Ethical approval

The study was approved by the Institutional human ethics committee of PSG IMSR prior to data collection. As this was a retrospective record-based study, informed consent was waived.

Study population

Patients of either sex diagnosed with solid or haematological malignancies and who had received at least one cycle of chemotherapy during the study period were eligible for inclusion. Only patients with complete medical records, including baseline and post-chemotherapy haemoglobin values, were included in the analysis.

Patients were excluded if they had documented anaemia prior to the initiation of chemotherapy or if they had received radiotherapy before the start of chemotherapy.

Study procedure and data collection

A total of 167 case records of patients who received chemotherapy during the study period were screened. Sixty-seven case records were excluded based on the predefined exclusion criteria. Data from the remaining 100 eligible patients were analysed.

Data were collected from the medical records department using a structured data collection form. Information recorded included demographic details, cancer diagnosis, chemotherapy regimen, class of chemotherapeutic agents, dose, number of cycles received, and any dose reduction or treatment delay. Laboratory parameters included haemoglobin levels measured before initiation of chemotherapy and after completion of chemotherapy cycles. Anaemia was graded according to standard severity criteria. Details regarding management of anaemia, including oral iron therapy, blood transfusion, vitamin supplementation, and other supportive measures, were documented. Patient outcomes were assessed based on improvement in haemoglobin levels and clinical status.

Study outcomes

The primary outcome was the incidence of CIA. Secondary outcomes included the magnitude of haemoglobin reduction following chemotherapy, the effect of different chemotherapeutic drug classes on haemoglobin levels, patterns of anaemia management, and patient outcomes.

Statistical analysis

Data were entered into Microsoft excel and analysed using statistical package for the social sciences (SPSS) software, version 26.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as frequency and percentage. Haemoglobin levels before and after chemotherapy were compared using paired t-test.

Differences in haemoglobin reduction across chemotherapeutic drug classes were analysed using one-way analysis of variance (ANOVA). A p value of less than 0.05 was considered statistically significant.

RESULTS

Study population

During the study period, a total of 167 case records of patients who received chemotherapy were screened. Sixty-seven case records were excluded based on the predefined exclusion criteria, including pre-existing anaemia prior to chemotherapy and receipt of radiotherapy before initiation of chemotherapy. The remaining 100 eligible patients were included in the final analysis.

Demographic and clinical characteristics

The demographic and clinical characteristics of the study population are summarized in Table 1. The majority of patients were in the age group of 50-59 years (33%), followed by 60-69 years (29%) and 40-49 years (24%). Patients aged 70 years and above constituted 6% of the study population, while those below 40 years accounted for 8%.

Table 1: Patient demographics and diagnosis.

Variables	Category	N (%)
Age group (in years)	<20	2 (2)
	20-29	2 (2)
	30-39	4 (4)
	40-49	24 (24)
	50-59	33 (33)
	60-69	29 (29)
	70+	6 (6)
Sex	Female	80 (80)
	Male	20 (20)
Diagnosis	Breast cancer	57 (57)
	Colon cancer	10 (10)
	Ovarian cancer	6 (6)
	Cervical cancer	4 (4)
	Stomach cancer	4 (4)
	Rectal cancer	3 (3)
	Pancreatic cancer	3 (3)
	Others*	13 (13)

*Others: Gallbladder (1), Lung (2), Esophagus (1), Oropharynx (2), Tonsil (1), Urethra (1), CML (1), Malignant Melanoma (1), NHL (2), Osteoblastic Osteosarcoma (1).

Female patients constituted the majority of the cohort (80%), while male patients accounted for 20%. With respect to cancer diagnosis, breast cancer was the most common malignancy, observed in 57% of patients. Colon cancer was the second most frequent diagnosis (10%), followed by ovarian cancer (6%). Other malignancies included cervical cancer (4%), stomach cancer (4%), rectal cancer (3%), pancreatic cancer (3%), and a heterogeneous group of other solid and haematological malignancies (13%).

Chemotherapeutic drug exposure

The distribution of chemotherapeutic drug classes administered to the study population is shown in Figure 1. Taxanes were the most frequently prescribed drug class (34%), followed by anthracycline antibiotics (29%). Alkylating agents and antimetabolites were used in 13% and 11% of patients, respectively. Other drug classes included platinum compounds, monoclonal antibodies, tyrosine kinase inhibitors, immune checkpoint inhibitors, aromatase inhibitors, and vinca alkaloids.

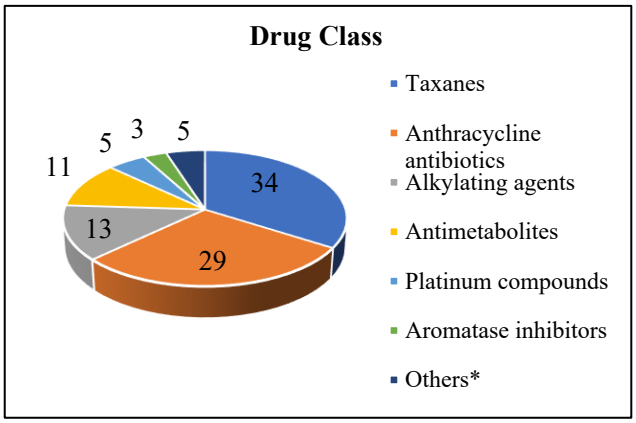

Figure 1: Distribution of chemotherapeutic drug classes among study participants.

*Others: Anti-CD20 monoclonal antibody (1), HER2/neu receptor antagonist (1), PD1 receptor inhibitor (1), Tyrosine kinase inhibitor (1), Vinca alkaloid (1).

Details regarding chemotherapy dose range and number of cycles are presented in Table 2. More than half of the patients (51%) received cumulative chemotherapy doses in the range of 101-200 units. Doses between 51 and 100 units were administered in 24% of patients, while higher dose ranges (>200 units) were observed in 26% of patients. With respect to treatment duration, the majority of patients (74%) received 4-6 cycles of chemotherapy. Fourteen percent of patients received 7-9 cycles, while 8% received 1-3 cycles and 4% received more than nine cycles.

Table 2: Dose range and number of chemotherapy cycles.

Variables	Category	N (%)
Dose range	≤50	9 (9)
	51-100	24 (24)
	101-200	51 (51)
	201-500	17 (17)
	501-1000	6 (6)
	>1000	3 (3)
No. of cycles	1-3	8 (8)
	4-6	74 (74)
	7-9	14 (14)
	>9	4 (4)

Incidence and severity of CIA

CIA was observed in varying degrees of severity across the study population. The distribution of anaemia grades is depicted in Figure 2. Grade 1 anaemia was the most commonly observed, occurring in 52% of patients. Grade 2 anaemia was observed in 27% of patients, while grade 3 anaemia was noted in 15%. Severe, life-threatening anaemia (grade 4) occurred in 6% of patients. Overall, mild-to-moderate anaemia accounted for the majority of cases, whereas severe anaemia was observed in a smaller but clinically significant proportion of patients.

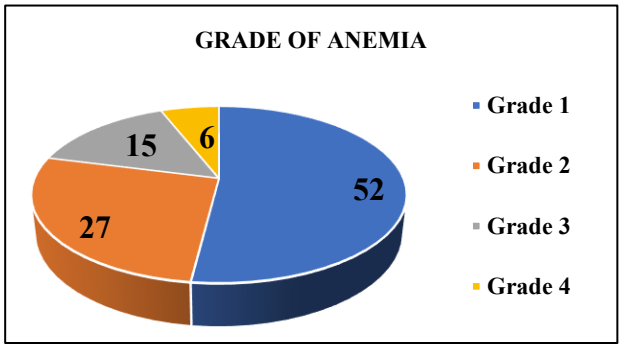

Figure 2: Distribution of grades of anaemia among study participants.

Change in haemoglobin levels following chemotherapy

Comparison of haemoglobin levels before and after chemotherapy revealed a statistically significant decline following treatment. The mean baseline haemoglobin level prior to chemotherapy was 13.40±0.90 g/dl. After completion of chemotherapy, the mean haemoglobin level decreased to 9.49±1.47 g/dl.

The mean reduction in haemoglobin was 3.91±1.65 g/dl, which was statistically significant (t=23.739; p<0.001). The paired comparison of haemoglobin levels before and after chemotherapy is presented in Table 3.

Effect of chemotherapeutic drug class on haemoglobin reduction

The extent of haemoglobin reduction varied among different chemotherapeutic drug classes, as shown in Table 4. The greatest mean haemoglobin reductions were observed in patients receiving PD-1 receptor inhibitors (5.90 g/dl), alkylating agents (5.38±2.10 g/dl), and anti-CD20 monoclonal antibodies (5.20 g/dl). Taxanes were associated with a mean haemoglobin reduction of 4.66±1.54 g/dl, while platinum compounds resulted in a reduction of 3.68±0.75 g/dl.

Lower mean haemoglobin reductions were observed with anthracycline antibiotics (2.81±0.84 g/dl), antimetabolites (2.86±0.87 g/dl), and aromatase inhibitors (2.67±0.15 g/dl). One-way analysis of variance demonstrated a statistically significant difference in haemoglobin reduction across drug classes (F=5.917; p=0.0001), indicating that the severity of CIA was influenced by the type of chemotherapeutic agent administered.

Management of anaemia and patient outcomes

The management strategies employed for CIA and patient outcomes are summarized in Table 5. No specific intervention was required in 35% of patients. Iron therapy was administered in 40% of patients, while packed red blood cell transfusions were required in 19%. Vitamin supplementation or other supportive measures were used in 6% of patients.

With respect to clinical outcomes, improvement was observed in 97% of patients following appropriate management of anaemia. Three patients (3%) died during the study period.

Table 3: Paired samples: HB before and HB after.

HB	Mean	SD	Mean difference	T	P value
Before	13.396	0.9006	3.91	23.739	<0.001
After	9.486	1.4737			

Table 4: Mean haemoglobin reduction by drug class.

Drug class	Hb reduction (Mean±SD)	
Alkylating agents	5.38±2.10	ANOVA F=5.917, p=0.0001
Anthracycline antibiotics	2.81±0.84	
Anti-CD20 monoclonal antibody	5.20	
Antimetabolite	2.86±0.87	
Aromatase inhibitor	2.67±0.15	
HER2/neu receptor antagonist	3.00	
PD1 receptor inhibitor	5.90	
Platinum compounds	3.68±0.75	
Taxanes	4.66±1.54	
Tyrosine kinase inhibitor	5.00	
Vinca Alkaloid	4.10	

Table 5: Management strategies and patient outcomes.

Variables	Category	N (%)
Management Type	No intervention	35 (35)
	Iron therapy	40 (40)
	PRBC transfusion	19 (19)
	Vitamin/misc.	6 (6)
Outcome	Improved	97 (97)
	Death	3 (3)

DISCUSSION

CIA remains one of the most frequent and clinically relevant adverse effects encountered during cancer treatment. In the present retrospective study, a statistically significant reduction in haemoglobin levels was observed following chemotherapy, with a mean decline of 3.91 g/dL. More than half of the patients developed grade 1 anaemia, while nearly one-fifth experienced severe or life-threatening anaemia. These findings reaffirm that CIA continues to represent a substantial burden in routine oncology practice, particularly in patients receiving multi-agent chemotherapy regimens.[1,9]

The incidence and severity of anaemia observed in this study are consistent with previously published large observational cohorts. The European cancer anaemia survey reported a high prevalence of anaemia during chemotherapy, with increasing severity over successive treatment cycles and in advanced disease stages.[1] Similar trends have been documented in prospective and retrospective studies across different cancer types and healthcare settings, confirming that CIA is a widespread and persistent clinical problem.[2,3,9] The predominance of mild-to-moderate anaemia in our cohort aligns with these reports; however, the occurrence of grade 3 and grade 4 anaemia highlights the potential for clinically significant haematological toxicity.

The pathogenesis of CIA is multifactorial. Cytotoxic chemotherapeutic agents exert direct myelosuppressive effects on erythroid progenitor cells, while inflammatory cytokines impair erythropoietin responsiveness and promote iron sequestration through hepcidin-mediated mechanisms.[5,6] In addition, functional and absolute iron deficiency, nutritional deficiencies, bone marrow infiltration, and cumulative chemotherapy exposure contribute to progressive haemoglobin decline.[7,8] These overlapping mechanisms likely explain the substantial haemoglobin reduction observed in the present study.

A key finding of this study was the significant variation in haemoglobin reduction across different chemotherapeutic drug classes. Greater reductions were observed with PD-1 receptor inhibitors, alkylating agents, anti-CD20 monoclonal antibodies, and taxanes. Previous studies have demonstrated that platinum- and taxane-based regimens are associated with a higher risk of moderate-to-severe anaemia, particularly with increasing numbers of chemotherapy cycles.[9,10] Although immune checkpoint inhibitors are generally considered less myelosuppressive, emerging evidence suggests that immune-mediated cytopenias, including autoimmune haemolytic anaemia and bone marrow suppression, may occur with PD-1 inhibitors, potentially explaining the pronounced haemoglobin reduction observed in this group.[14]

The clinical consequences of CIA extend beyond laboratory abnormalities. Even moderate reductions in haemoglobin levels can result in fatigue, dyspnoea, reduced physical functioning, and impaired quality of life.[11] Furthermore, CIA has been shown to increase the likelihood of chemotherapy dose reductions, treatment delays, and early discontinuation, which may compromise treatment efficacy and adversely affect oncological outcomes.[15] The magnitude of haemoglobin reduction observed in our cohort is therefore clinically meaningful and underscores the importance of proactive anaemia management.

In the present study, anaemia was primarily managed with iron therapy and packed red blood cell transfusions, reflecting real-world clinical practice in many tertiary care centres. The limited use of erythropoiesis-stimulating agents is consistent with current trends following concerns regarding thromboembolic risk, tumour progression, and overall survival associated with their use.[4,16] Similar management patterns have been reported in observational studies from both high-income and resource-limited settings, emphasizing the need for individualized, risk-based approaches to anaemia management.[12,13] Encouragingly, the majority of patients in this study demonstrated clinical improvement following appropriate intervention.

This study has certain limitations inherent to its retrospective design, including reliance on medical records, lack of data on iron indices and inflammatory markers, and the inability to assess long-term outcomes such as progression-free and overall survival. Despite these limitations, the study provides valuable real-world data on the incidence, severity, and management of CIA in an Indian tertiary care setting, where published evidence remains limited.

Overall, the findings of this study emphasize the need for routine haemoglobin monitoring, early identification of high-risk patients based on chemotherapy regimen and treatment intensity, and timely, individualized management strategies. Such an approach may help minimize treatment interruptions, improve patient quality of life, and optimize cancer treatment outcomes.

CONCLUSION

This retrospective observational study highlights CIA as a common and clinically significant adverse effect among patients receiving anticancer therapy in a tertiary care setting. A substantial and statistically significant reduction in haemoglobin levels was observed following

chemotherapy, with anaemia occurring across all grades of severity. The findings demonstrate that the magnitude of haemoglobin decline varies according to the class of chemotherapeutic agent, with greater reductions noted among patients treated with PD-1 receptor inhibitors, alkylating agents, and taxanes, underscoring the influence of treatment regimen on haematological toxicity.

Although most cases of anaemia were mild to moderate, a notable proportion of patients developed severe or life-threatening anaemia, emphasizing the need for vigilant monitoring. The majority of patients were managed effectively using iron supplementation and supportive care measures, while a smaller proportion required blood transfusion. Favourable clinical outcomes observed in most patients suggest that timely recognition and appropriate management of anaemia can mitigate its adverse effects and support continuity of chemotherapy.

Overall, the study underscores the importance of routine haemoglobin monitoring, early identification of patients at higher risk for CIA, and individualized management strategies tailored to both patient characteristics and chemotherapy regimens. Incorporating proactive anaemia assessment into routine oncology practice may help reduce treatment interruptions, improve patient quality of life, and optimize therapeutic outcomes. Further prospective studies are warranted to explore long-term outcomes and to evaluate standardized anaemia management protocols in diverse cancer populations.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ludwig H, Van Belle S, Barrett-Lee P, Birgegård G, Bokemeyer C, Gascón P, et al. The European Cancer Anaemia Survey (ECAS): a large, multinational, prospective survey defining the prevalence, incidence, and treatment of anaemia in cancer patients. Eur J Cancer. 2004;40(15):2293-306.
2. Saint A, Viotti J, Borchiellini D, Hoch B, Raimondi V, Hebert C, et al. Iron deficiency during first-line chemotherapy in metastatic cancers: a prospective epidemiological study. Support Care Cancer. 2020;28(4):1639-47.
3. Macciò A, Madeddu C, Gramignano G, Mulas C, Tanca L, Cherchi MC, et al. The role of inflammation, iron, and nutritional status in cancer-related anemia: results of a large prospective observational study. Haematologica. 2015;100(1):124-32.
4. Gilreath JA, Rodgers GM. How I treat cancer-associated anemia. Blood. 2020;136(7):801-13.
5. Abdel-Razeq H, Hashem H. Recent update in the pathogenesis and treatment of chemotherapy- and cancer-induced anemia. Crit Rev Oncol Hematol. 2020;145:102837.
6. Weiss G, Ganz T, Goodnough LT. Anemia of inflammation. Blood. 2019;133(1):40-50.
7. Camaschella C, Girelli D. The changing landscape of iron deficiency. Mol Aspects Med. 2020;75:100861.
8. Busti F, Marchi G, Ugolini S, Castagna A, Girelli D. Anemia and iron deficiency in cancer patients: role of iron replacement therapy. Pharmaceuticals (Basel). 2018;11(4):94.
9. Xu H, Xu L, Page JH, Cannavale K, Sattayapiwat O, Rodriguez R, et al. Incidence of anemia in patients diagnosed with solid tumors receiving chemotherapy, 2010-2013. Clin Epidemiol. 2016;8:61-71.
10. Cannavale K, Xu H, Xu L, Sattayapiwat O, Rodriguez R, Bohac C, et al. Epidemiology of chemotherapy-induced anemia in patients with non-Hodgkin lymphoma. Perm J. 2019;23:18-252.
11. Family L, Xu L, Xu H, Cannavale K, Sattayapiwat O, Page JH, et al. The effect of chemotherapy-induced anemia on dose reduction and dose delay. Support Care Cancer. 2016;24(10):4263-71.
12. Badheeb AM, Ahmed F, Badheeb MA, Obied HY, Seada IA, Al Jumman A, et al. Anemia profiles in cancer patients: prevalence, contributing factors, and insights from a retrospective study at a single cancer center in Saudi Arabia. Cureus. 2023;15(7):e42400.
13. Wondm SA, Dagnew SB, Gubae K, Tesfaye TC, Tamene FB. Determinants of anemia among patients receiving cancer chemotherapy in Northwest Ethiopia. Front Med (Lausanne). 2024;11:1415877.
14. Delanoy N, Michot JM, Comont T, Kramkimel N, Lazarovici J, Dupont R, et al. Haematological immune-related adverse events induced by anti-PD-1 or anti-PD-L1 immunotherapy: a descriptive observational study. Lancet Haematol. 2019;6(1):e48-57.
15. Caro JJ, Salas M, Ward A, Goss G. Anemia as an independent prognostic factor for survival in patients with cancer: a systematic, quantitative review. Cancer. 2001;91(12):2214-21.
16. Bohlius J, Schmidlin K, Brillant C, Schwarzer G, Trelle S, Seidenfeld J, et al. Erythropoietin or darbepoetin for patients with cancer. Cochrane Database Syst Rev. 2009;(3):CD003407.

Cite this article as: Sowmiya D, Suthish B, Bhuvaneswari K. Retrospective study on chemotherapy–induced anaemia: incidence, treatment patterns and outcomes in a tertiary care hospital in South India. Int J Basic Clin Pharmacol 2026;15:239-44.