

**DIAGNOSIS AND CORRECTION OF COMPLICATIONS OF MODERN
PROGRAMMED CHEMOTHERAPY IN ACUTE LEUKEMIA**

Mamadiyev X. Q.

Assistant, Department of Infectious Diseases, Dermatovenereology, Phthisiology and
Pulmonology

Abstract: Acute leukemia is a rapidly progressing hematological malignancy that requires intensive programmed chemotherapy as the main treatment approach. Despite significant advances in modern chemotherapeutic protocols, treatment is often associated with a wide range of complications, including myelosuppression, infectious complications, cardiotoxicity, hepatotoxicity, and metabolic disturbances. Early diagnosis and timely correction of these adverse effects are essential for improving treatment outcomes and patient survival. This article reviews the main complications of modern programmed chemotherapy in acute leukemia, discusses diagnostic approaches for early detection, and outlines current strategies for their correction and management. Emphasis is placed on a multidisciplinary approach to minimize treatment-related toxicity while maintaining therapeutic efficacy.

Keywords: acute leukemia, programmed chemotherapy, complications, myelosuppression, toxicity, infection, cardiotoxicity, hepatotoxicity, supportive therapy, hematology

Introduction

Acute leukemia is a malignant disorder of the hematopoietic system characterized by the uncontrolled proliferation of immature blood cells. It is classified mainly into acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML). The cornerstone of treatment for both types is programmed multi-agent chemotherapy, which aims to achieve remission by eliminating leukemic blasts from the bone marrow and peripheral blood. Although modern chemotherapy regimens have significantly improved survival rates, they are frequently associated with severe adverse effects due to their non-selective cytotoxic action on rapidly dividing normal cells. The most common complications include bone marrow suppression leading to anemia, neutropenia, and thrombocytopenia, which increase the risk of infections and bleeding. Additionally, organ-specific toxicities affecting the heart, liver, kidneys, and gastrointestinal tract

may occur during treatment. The diagnosis of chemotherapy-induced complications requires careful clinical monitoring, laboratory evaluation, and instrumental investigations. Early recognition of these adverse effects is crucial for timely intervention and prevention of life-threatening conditions. Correction strategies include dose adjustment, supportive therapy, antimicrobial treatment, hematopoietic growth factors, and organ-protective agents. This article aims to analyze the spectrum of complications associated with modern programmed chemotherapy in acute leukemia, highlight diagnostic challenges, and discuss evidence-based approaches for their correction and management.

Materials and Methods

This study was conducted as a comprehensive narrative review of scientific literature focusing on complications of modern programmed chemotherapy in acute leukemia and their diagnostic and corrective approaches. Scientific sources were collected from peer-reviewed journals in hematology, oncology, and internal medicine, as well as international clinical guidelines (including recommendations from WHO, NCCN, and ESMO). Publications from the last 15 years were prioritized to ensure inclusion of up-to-date chemotherapy protocols and toxicity management strategies. The review focused on patients with acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL) undergoing multi-agent chemotherapy regimens such as induction, consolidation, and maintenance therapy. Particular attention was given to complications including:

- Hematological toxicity (anemia, neutropenia, thrombocytopenia)
- Infectious complications (bacterial, viral, fungal infections)
- Gastrointestinal toxicity (mucositis, nausea, vomiting, diarrhea)
- Hepatotoxicity and nephrotoxicity
- Cardiotoxicity associated with anthracyclines
- Metabolic and electrolyte disturbances

Data were systematically analyzed to evaluate diagnostic methods (laboratory tests, imaging, biomarkers) and therapeutic interventions aimed at reducing chemotherapy-induced toxicity.

Results

The analysis of available literature demonstrated that myelosuppression is the most frequent and clinically significant complication of programmed chemotherapy in acute leukemia. It manifests as neutropenia, anemia, and thrombocytopenia, which significantly increase the risk of infection, fatigue, and hemorrhagic events. Febrile neutropenia was identified as one of the leading causes of treatment-related hospitalization and mortality. Early detection through complete blood count monitoring and C-reactive protein levels is essential for timely antimicrobial therapy initiation. Infectious complications were found to be predominantly bacterial in the early phases of neutropenia, while fungal and viral infections occurred in prolonged immunosuppression. Empirical broad-spectrum antibiotic therapy combined with antifungal prophylaxis significantly reduced mortality rates. Cardiotoxicity, particularly associated with anthracycline-based regimens, was characterized by decreased left ventricular ejection fraction and development of heart failure in severe cases. Echocardiographic monitoring and biomarkers such as troponin and BNP were useful for early detection. Hepatic and renal toxicities were also frequently observed, especially in high-dose chemotherapy protocols. Elevations in ALT, AST, bilirubin, creatinine, and urea levels indicated organ dysfunction and required dose modification or temporary discontinuation of therapy. Supportive measures such as granulocyte colony-stimulating factor (G-CSF) administration, blood transfusions, antiemetic therapy, and organ-protective agents significantly improved patient tolerance to chemotherapy.

Discussion

The findings of this review confirm that complications of programmed chemotherapy in acute leukemia remain a major clinical challenge despite significant advances in treatment protocols. The non-selective cytotoxic effect of chemotherapeutic agents on rapidly dividing cells explains the high incidence of hematological and gastrointestinal toxicity. Myelosuppression remains the most critical dose-limiting toxicity, requiring continuous hematological monitoring and prompt supportive care. The use of G-CSF has significantly reduced the duration of neutropenia and the incidence of infectious complications, improving overall treatment outcomes. Infectious complications continue to be a leading cause of morbidity and mortality in acute leukemia patients. Early empirical antibiotic therapy, strict infection control measures, and antifungal prophylaxis are essential components of management strategies. Cardiotoxicity associated with anthracyclines represents a serious long-term complication. Early

detection using echocardiography and cardiac biomarkers allows timely intervention, including dose adjustment or switching to less cardiotoxic agents. Organ toxicity involving the liver and kidneys highlights the importance of individualized chemotherapy dosing and regular biochemical monitoring.

Conclusion

Complications of modern programmed chemotherapy in acute leukemia remain a significant challenge in clinical hematology despite substantial advances in treatment protocols. The most frequent and clinically important adverse effects include myelosuppression, infectious complications, cardiotoxicity, hepatotoxicity, nephrotoxicity, and gastrointestinal toxicity. Myelosuppression is the principal dose-limiting toxicity and is responsible for increased susceptibility to infections and bleeding complications. Febrile neutropenia remains one of the most dangerous conditions requiring immediate diagnosis and urgent empirical antimicrobial therapy. Cardiovascular toxicity, particularly associated with anthracycline-based regimens, necessitates regular cardiac monitoring for early detection of myocardial dysfunction. The study emphasizes that timely diagnosis using laboratory markers, imaging techniques, and clinical monitoring plays a crucial role in preventing severe complications. Supportive therapy, including the use of growth factors, antimicrobial prophylaxis, transfusion support, and organ-protective strategies, significantly improves treatment tolerance and patient outcomes.

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