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Perspective

Advancements in Targeted Therapy for Acute Lymphoblastic Leukemia

Emily Jons*

Department of Oncology, Mount Kenya University, Thika, Kenya

DESCRIPTION

Acute leukemia is a type of blood cancer characterized by the rapid proliferation of abnormal white blood cells that impair the body's ability to fight infections, oxygenate tissues, and control bleeding. Unlike chronic leukemia, where the disease progresses more slowly, acute leukemia manifests abruptly and often leads to life-threatening complications. Given its aggressive nature, early detection and intervention are critical in improving patient outcomes.

Types of acute leukemia

Acute leukemia is primarily classified into two major types based on the origin of the abnormal white blood cells:

Acute Lymphoblastic Leukemia (ALL): ALL involves the overproduction of lymphoblasts (immature lymphocytes) and is more commonly diagnosed in children, although it can also affect adults. This subtype is further classified into B-cell ALL and T-cell ALL, depending on which type of lymphocyte is involved.

Acute Myeloid Leukemia (AML): AML arises from the malignant transformation of myeloid stem cells, leading to the rapid production of abnormal myeloid cells. This type of leukemia is more prevalent in adults, particularly those over the age of 60, and is associated with various genetic mutations and risk factors, such as exposure to chemotherapy, radiation, or chemicals like benzene. AML has a poorer survival rate compared to ALL, partly due to its aggressive progression and the difficulty of treating older patients with underlying health issues.

Both types of acute leukemia can present with similar symptoms, but their biological behavior, response to treatment, and prognosis can vary significantly.

Treatment options

The treatment of acute leukemia has seen significant advancements over the years, with the goal of achieving remission and preventing relapse. Treatment protocols are often divided into several phases: induction, consolidation, and maintenance therapy. The specific approach depends on the type of leukemia, patient age, and overall health.

Chemotherapy: Chemotherapy remains the cornerstone of treatment for both ALL and AML. In ALL, a combination of chemotherapy drugs is used to achieve remission. Common agents include vincristine, methotrexate, and prednisolone. For AML, treatment often involves a combination of anthracyclines and cytarabine during induction therapy.

Bone marrow transplantation: Hematopoietic Stem Cell Transplantation (HSCT), also known as bone marrow transplantation, is an important treatment option, especially for patients with high-risk disease or those who relapse. The procedure involves replacing the patient's diseased bone marrow with healthy stem cells from a donor. This option can be curative for many patients but comes with significant risks, such as graft-*versus*-host disease and infection.

Targeted therapy: Targeted therapies have revolutionized the treatment of leukemia, particularly in cases with specific genetic mutations. For example, Tyrosine Kinase Inhibitors (TKIs) like imatinib are used for Philadelphia chromosome-positive ALL, while *FLT3* inhibitors are used in AML cases with *FLT3* mutations. These therapies aim to block the molecular signals that drive the growth of leukemic cells.

Immunotherapy: Immunotherapy has emerged as a promising treatment option for acute leukemia, particularly with the advent of CAR-T (Chimeric Antigen Receptor T-cell) therapy. This treatment involves modifying the patient's T-cells to express a receptor that targets and destroys leukemic cells. CAR-T therapy has shown significant success in treating relapsed or refractory ALL, especially in children and young adults.

Supportive care: Supportive care is an essential part of leukemia treatment. This includes blood transfusions to manage anemia and thrombocytopenia, antibiotics to treat infections, and medications to manage side effects such as nausea, pain, and fatigue. Given the intense nature of leukemia treatments, patients often require extensive supportive care to improve their

Correspondence to: Emily Jons, Department of Oncology, Mount Kenya University, Thika, Kenya, E-mail: jonse@gmail.com

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quality of life and help them recover from treatment-related side effects.

CONCLUSION

Acute leukemia remains a challenging and life-threatening condition, but advances in diagnosis and treatment have significantly improved patient outcomes. While chemotherapy and stem cell transplantation continue to be the mainstay of treatment, targeted therapies and immunotherapy offer new hope for patients with relapsed or refractory disease. Ongoing research into the genetic and molecular mechanisms of leukemia will likely lead to even more personalized and effective treatments in the future. Early detection, prompt treatment, and a multidisciplinary approach to care remain essential in improving survival rates and the quality of life for individuals diagnosed with acute leukemia.