



LEUKEMIA: CAUSES, DIAGNOSIS, AND TREATMENT METHODS

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Abstract

Leukemia is a malignant disease of the blood and blood-forming tissues characterized primarily by disruption of the normal production of blood cells in the bone marrow. In this condition, immature or abnormal white blood cells proliferate uncontrollably and interfere with the production of normal erythrocytes, thrombocytes, and healthy leukocytes. As a result, decreased immunity, impaired oxygen transport, and abnormalities in blood clotting occur in the body. Leukemia is one of the most common oncological diseases worldwide and can affect both children and adults. Depending on the rate of progression, origin, and type of affected cell, the disease is classified into several forms.

Keywords: leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, acute myeloid leukemia, chronic myeloid leukemia, Down syndrome, Li-Fraumeni syndrome, ataxia-telangiectasia, Philadelphia chromosome.

Leukemia is a malignant disorder of the blood and hematopoietic tissues mainly characterized by impairment of the normal process of blood cell formation in the bone marrow. In this disease, immature or abnormal white blood cells multiply uncontrollably and suppress the production of normal red blood cells, platelets, and healthy leukocytes. Consequently, the immune system weakens, oxygen transport becomes impaired, and blood coagulation disorders develop. Leukemia is among the most prevalent oncological diseases globally and may occur in both pediatric and adult populations. Based on the speed of progression, origin, and the type of affected cells, leukemia is divided into several major forms. The principal types include acute lymphoblastic leukemia, chronic lymphocytic leukemia, acute myeloid leukemia, and chronic myeloid leukemia. Acute leukemias progress rapidly and produce severe clinical manifestations within a short period. In such cases, the number of blast cells in the bone marrow increases dramatically. Chronic leukemia, on the other hand, develops gradually and may remain asymptomatic during its early stages. Acute lymphoblastic leukemia is more commonly observed in children, whereas chronic lymphocytic leukemia usually occurs in older adults. Myeloid leukemias involve damage to myeloid cells, while lymphoid leukemias affect lymphocytes undergoing pathological transformation. Although the exact causes of leukemia have not been fully elucidated, several risk factors have been identified. Genetic mutations and chromosomal abnormalities are considered the primary causes. In some cases, translocation between chromosomes 9 and 22 results in the formation of the Philadelphia chromosome, which contributes to the development of chronic myeloid leukemia. Exposure to radiation, prolonged contact with harmful chemicals—particularly benzene—smoking, and certain viral infections also increase the risk of the disease. Furthermore, hereditary conditions such as Down syndrome, Li-Fraumeni syndrome, and ataxia-telangiectasia predispose individuals to leukemia. Certain chemotherapeutic agents used in cancer treatment may also subsequently induce leukemia development. The clinical manifestations of leukemia vary depending on the type and stage of the disease. The most common symptoms include persistent weakness, fatigue, fever, night sweats, recurrent infections, nosebleeds, and bruising of the skin. A decrease in erythrocyte count leads to



anemia, resulting in dizziness and shortness of breath. Reduced platelet levels impair blood clotting. In some patients, enlargement of lymph nodes, spleen, and liver may occur. If leukemic cells spread to the central nervous system, symptoms such as headaches, vomiting, seizures, and neurological disturbances may develop. The diagnosis of leukemia is performed in several stages. Initially, a complete blood count is conducted, which may reveal increased or decreased leukocyte levels as well as reduced erythrocyte and platelet counts. Subsequently, a peripheral blood smear is examined microscopically. One of the most important diagnostic methods is bone marrow biopsy, which allows determination of the quantity and type of blast cells. In addition, immunological and cytogenetic investigations help identify chromosomal abnormalities. Imaging methods such as computed tomography and magnetic resonance imaging are also used to evaluate the extent of disease dissemination throughout the body. The treatment of leukemia is complex and prolonged, depending on the disease type, patient age, and overall health status. Chemotherapy remains the primary treatment modality. In chemotherapy, special medications aimed at destroying cancer cells are administered intravenously or orally. In certain cases, drugs are also introduced into the cerebrospinal fluid. Common side effects of chemotherapy include hair loss, nausea, vomiting, weakness, and immunosuppression. One of the modern therapeutic approaches is biological therapy, which enhances the immune system's ability to combat cancer cells. Targeted therapy utilizes agents that specifically affect certain proteins or genetic abnormalities found in malignant cells. Radiation therapy may be applied to the brain or other affected regions in selected cases. One of the most effective treatment methods is stem cell transplantation, in which the patient's damaged bone marrow is replaced with healthy donor stem cells. This approach may provide complete remission and recovery in some patients. Although leukemia prevention cannot be fully guaranteed, several preventive measures may help reduce the risk. Avoiding excessive exposure to radiation and toxic chemicals, quitting smoking, and maintaining a healthy lifestyle are essential. Strengthening immunity, proper nutrition, and regular medical examinations facilitate early disease detection. Individuals with a family history of leukemia are advised to seek genetic counseling. Patients who have undergone intensive chemotherapy or radiation therapy for cancer treatment should remain under continuous medical supervision.

In conclusion, leukemia is a serious oncological disease of the hematological system that negatively affects numerous vital functions of the body. Owing to advancements in modern medicine, opportunities for early diagnosis and effective treatment are steadily expanding. Early detection and timely treatment significantly improve patient survival rates. Therefore, increasing public medical awareness and strengthening preventive measures are of great importance.

Childhood Leukemia: Childhood leukemia is one of the most common oncological diseases among children. According to international scientific journals, this disease is characterized by uncontrolled proliferation of immature white blood cells in the bone marrow. Acute lymphoblastic leukemia is the most common type in children and accounts for approximately 25% of all pediatric cancers. The disease is most frequently diagnosed between the ages of 2 and 5 years. The primary cause of leukemia in children is genetic mutation within cells. Research indicates that chromosomal abnormalities associated with leukemia may develop during fetal life. Subsequently, environmental factors or immune system dysfunctions may accelerate disease progression. In particular, the Philadelphia chromosome formed by translocation between chromosomes 9 and 22 plays a significant role in certain leukemia types. International studies identify radiation exposure, pesticides, benzene, parental occupational exposure to harmful industrial substances, smoking, and certain viral infections as major risk factors contributing to childhood leukemia. Moreover, children with hereditary conditions such as Down syndrome are at a higher risk of developing leukemia. According to the



International Agency for Research on Cancer, environmental and prenatal factors may play a substantial role in the development of childhood leukemia. Early symptoms of the disease include weakness, rapid fatigue, fever, bone and joint pain, bruising of the skin, nosebleeds, enlargement of lymph nodes, and recurrent infections. This occurs because pathological blast cells suppress the production of healthy erythrocytes, platelets, and normal leukocytes.

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