CONDITION

Acute lymphoblastic leukemia

Learn about acute lymphoblastic leukemia symptoms, diagnosis, treatment phases, possible complications, and the follow-up care people with ALL may need.

WHAT IT IS
Cancer of the blood and bone marrow

BODY SYSTEM
Blood and bone marrow

MAIN SYMPTOMS
Tiredness, frequent infections, unexplained fever, unusual bleeding

WHAT CAUSES IT
Genetic changes, usually of unknown cause

HOW IT IS DIAGNOSED
Bone marrow aspiration and biopsy

MAIN TREATMENT
Multi-phase chemotherapy

CAN IT BE CURED?
Sometimes - transplant can offer long-term control

IS IT AN EMERGENCY?
Sometimes - bleeding that does not stop

LONG-TERM OUTLOOK
Variable, with possible relapse and long-term treatment effects

Overview

Acute lymphoblastic leukemia, often called ALL, is a cancer of the blood and bone marrow. The bone marrow is the soft tissue inside certain bones where blood cells are made.

ALL begins when an immature white blood cell called a lymphoblast develops abnormal genetic changes. The cell then grows and divides without normal control. These leukemia cells can build up in the bone marrow and interfere with the production of healthy red blood cells, white blood cells, and platelets.

"Acute" means that the disease can progress quickly without treatment. "Lymphoblastic" refers to the immature lymphoid cells involved. Most cases begin in developing B cells, while others begin in developing T cells. B cells and T cells are parts of the immune system.

ALL can occur at any age. It is the most common type of cancer in children, but adults can also develop it. The exact disease features, treatment plan, and outlook often differ between children, adolescents, younger adults, and older adults.

Leukemia cells may remain mainly in the blood and bone marrow, but they can also reach the lymph nodes, spleen, liver, brain, spinal cord, or other tissues. Prompt assessment and treatment matter because ALL usually worsens if it is not treated.

Symptoms

ALL symptoms often develop over days or weeks. They may be caused by low levels of normal blood cells, leukemia cells in particular organs, or both. These symptoms can also occur with many conditions that are not cancer.

Possible symptoms include:

T-cell ALL can sometimes cause a mass in the chest where the thymus gland is located. This may lead to coughing, chest pressure, difficulty breathing, or swelling of the face, neck, or arms.

Arrange a prompt medical assessment for ongoing unexplained fever, unusual bleeding, worsening fatigue, repeated infections, or several symptoms occurring together. These concerns usually require blood testing but do not by themselves confirm leukemia.

Seek emergency care for severe difficulty breathing, chest pain, confusion, a seizure, fainting, sudden weakness, or bleeding that does not stop. People already receiving ALL treatment should contact their oncology team immediately for fever or signs of infection, using the temperature and contact instructions provided by the team.

- Tiredness, weakness, pale skin, dizziness, or shortness of breath from too few red blood cells
- Frequent, severe, or slow-to-improve infections
- Fever without a clear cause
- Easy bruising, small red or purple skin spots, bleeding gums, or frequent nosebleeds from too few platelets
- Bone, joint, or abdominal pain
- Swollen lymph nodes, often in the neck, armpit, or groin
- A feeling of fullness below the ribs from an enlarged liver or spleen
- Reduced appetite or unintended weight loss

- Night sweats
- Headache, vomiting, vision changes, weakness, or other nervous system symptoms

Causes and risk factors

ALL develops because of genetic changes within an immature blood-forming cell. These changes affect how the cell grows, matures, or dies. In most people, it is not possible to identify why the changes occurred.

ALL is generally not caused by something a person did. It is not contagious, and it cannot spread from one person to another. Most people who develop ALL have no clear risk factor.

Factors associated with an increased risk include:

Having a risk factor does not mean that a person will develop ALL. Likewise, someone without a known risk factor can still develop it. Routine screening is not generally available for people without symptoms, although those with certain inherited conditions may receive specialist monitoring.

- Certain inherited conditions, including Down syndrome and some rare disorders that affect DNA repair or cancer risk
- Previous treatment with certain chemotherapy medicines
- Previous exposure to radiation therapy
- High levels of ionizing radiation
- A personal or family history suggesting a rare inherited leukemia-predisposition syndrome

Diagnosis

Evaluation usually begins with a medical history, physical examination, and complete blood count. A complete blood count measures red blood cells, white blood cells, and platelets. The results may show anemia, a low platelet count, or an unusual number or type of white blood cells.

A blood smear allows a laboratory professional to examine the shape and maturity of blood cells under a microscope. However, blood tests alone are not always enough to confirm or exclude ALL.

A bone marrow aspiration and biopsy are usually needed. During these procedures, a clinician

removes liquid marrow and a small piece of marrow tissue, commonly from the back of the hip bone. Local anesthetic is used to numb the area, and sedation may be available. Specialists examine the samples for leukemia cells.

Additional laboratory tests help classify the leukemia:

A lumbar puncture, sometimes called a spinal tap, tests the fluid surrounding the brain and spinal cord. It may also be used to give treatment that helps prevent or control leukemia in the central nervous system. Imaging tests are used when symptoms or examination findings suggest involvement of the chest, brain, or another organ.

Doctors combine these results with the person's age, general health, leukemia subtype, genetic findings, and response to early treatment. This information guides treatment and helps estimate the chance that the leukemia will return.

- Flow cytometry identifies proteins on the leukemia cells and helps determine whether the cells are from the B-cell or T-cell line.
- Chromosome testing looks for missing, added, or rearranged genetic material.
- Molecular testing checks for specific gene changes, such as the BCR::ABL1 fusion, also called the Philadelphia chromosome.
- Measurable residual disease testing , or MRD testing, looks for very small numbers of leukemia cells that may remain after treatment begins.

Treatment and management

ALL treatment should be planned by a team experienced in blood cancers. Care may involve hematologists, oncologists, specialist nurses, pharmacists, pathologists, infectious disease clinicians, and other professionals. Pediatric and adult treatment programs use different protocols, although their main goals are similar.

Treatment commonly occurs in several phases:

Chemotherapy is a central part of treatment. Several medicines are combined because they attack leukemia cells in different ways. Corticosteroids like prednisone or hydrocortisone are also commonly included. The exact medicines, schedule, and length of treatment depend on the treatment protocol and individual disease features.

Some people receive targeted or immune-based therapies. For example, tyrosine kinase inhibitors target the abnormal protein produced by BCR::ABL1-positive ALL. Blinatumomab helps immune cells recognize CD19-positive leukemia cells, while inotuzumab ozogamicin targets CD22. CAR T-cell therapy modifies a person's own immune cells so they can recognize

a target on leukemia cells. These treatments are appropriate only in specific situations and can have serious side effects requiring specialist monitoring.

A stem cell transplant may be considered for selected people with high-risk disease, persistent MRD, or leukemia that has returned. Before the transplant, intensive treatment prepares the body to receive blood-forming stem cells from a donor. Transplant can offer long-term disease control, but it also carries major short-term and long-term risks.

Supportive care is an essential part of treatment. It may include blood or platelet transfusions, medicines to prevent or treat infection, nausea control, pain management, and steps to prevent tumor lysis syndrome. Tumor lysis syndrome occurs when many leukemia cells break down quickly and release substances that can harm the kidneys, heart, or other organs.

Treatment can affect fertility. When time and health allow, patients or families may wish to discuss fertility preservation before therapy begins. Emotional support, nutrition care, rehabilitation, school services, and financial counseling may also be helpful. Participation in a clinical trial may provide access to carefully monitored treatment approaches and can be discussed with the care team.

- Induction aims to achieve remission, meaning that routine testing no longer finds clear evidence of leukemia and normal blood production begins to recover.
- Consolidation or intensification treats leukemia cells that may remain after remission.
- Maintenance uses less intensive treatment over a longer period to reduce the chance of relapse.
- Central nervous system treatment helps prevent or treat leukemia in the brain and spinal cord.

Complications

ALL itself can cause serious problems by crowding healthy cells out of the bone marrow. Too few normal white blood cells can increase infection risk. Low platelets can cause bleeding, while low red blood cells can lead to significant anemia.

Leukemia cells may affect the brain and spinal cord, lymph nodes, liver, spleen, or testes. A large number of leukemia cells can sometimes interfere with normal blood flow in small vessels, although this is less common in ALL than in some other leukemias.

Treatment complications vary by medicine and treatment phase. They may include infections, bleeding, mouth sores, nausea, hair loss, nerve problems, blood clots, liver changes, or damage to other organs. Immune-based treatments can cause intense inflammation or nervous system

effects. Transplant can lead to graft-versus-host disease, in which donor immune cells attack the recipient's tissues.

Some treatment effects appear months or years later. Possible long-term concerns include heart or bone problems, hormone changes, effects on learning or memory, infertility, and second cancers. The risk depends on age, the medicines and radiation received, and other health factors.

Relapse means that ALL has returned after remission. It may return in the marrow or another site. Treatment options depend on the leukemia subtype, previous therapy, timing and location of relapse, and whether targetable features are present.

Follow up

During treatment, follow-up is frequent. Blood counts help the team measure marrow recovery, infection risk, and bleeding risk. Bone marrow examinations and MRD testing show how well the leukemia is responding. Other tests monitor the liver, kidneys, heart, or nervous system when relevant to the treatment being used.

Keep the oncology team's contact information available. Report fever, chills, new bleeding, exposure to certain infections, uncontrolled vomiting or diarrhea, worsening pain, or new neurologic symptoms promptly. Do not start medicines, supplements, or vaccines without checking with the treatment team because some may interact with therapy or may not be appropriate during periods of weakened immunity.

After treatment, visits gradually become less frequent. Follow-up looks for relapse, treatment-related health effects, and emotional or practical concerns. Survivors may receive a written care summary describing their diagnosis, treatment exposures, and recommended long-term monitoring.

Routine primary care remains important. This includes age-appropriate preventive care, dental care, physical activity, and vaccinations coordinated with the oncology team. New symptoms do not always mean that leukemia has returned, but persistent or unexplained changes should be discussed rather than waiting for the next scheduled visit.

Sources

- National Cancer Institute. Adult Acute Lymphoblastic Leukemia Treatment (PDQ®)-Health Professional Version . PDQ Cancer Information Summaries. Bethesda, MD: National Cancer Institute.
- National Cancer Institute. Childhood Acute Lymphoblastic Leukemia Treatment (PDQ®)-Health Professional Version . PDQ Cancer Information Summaries. Bethesda, MD: National Cancer Institute.
- National Comprehensive Cancer Network. NCCN Guidelines for Patients: Acute Lymphoblastic Leukemia . Plymouth Meeting, PA: National Comprehensive Cancer Network; 2024.
- Malard F, Mohty M. Acute lymphoblastic leukaemia. The Lancet . 2020;395(10230):1146-1162.
- Alaggio R, Amador C, Anagnostopoulos I, et al. The 5th edition of the World Health Organization Classification of Haematolymphoid Tumours: Lymphoid Neoplasms. Leukemia . 2022;36:1720-1748.