CONDITION

B-cell acute lymphoblastic leukemia for adults

Learn about symptoms, diagnosis, treatment, complications, and follow-up care for adults with B-cell acute lymphoblastic leukemia.

WHAT IT IS
Fast-growing cancer of blood and bone marrow

BODY SYSTEM
Blood and immune system

MAIN SYMPTOMS
Fatigue, repeated infections, easy bruising or bleeding, bone or joint discomfort

WHAT CAUSES IT
Usually unknown, with acquired DNA changes

HOW IT IS DIAGNOSED
Bone marrow aspiration and biopsy, flow cytometry

MAIN TREATMENT
Chemotherapy, targeted therapy, immunotherapy, sometimes stem cell transplantation

CAN IT BE CURED?
Sometimes - treatment can produce remission

IS IT AN EMERGENCY?
Sometimes - uncontrolled bleeding or severe breathing difficulty

LONG-TERM OUTLOOK
Fast progression without treatment and possible relapse

Overview

B-cell acute lymphoblastic leukemia, often called B-ALL, is a fast-growing cancer of the blood and bone marrow. It begins in immature white blood cells called B lymphoblasts. These cells would normally develop into B lymphocytes, which help the immune system make antibodies.

In B-ALL, abnormal lymphoblasts multiply without maturing. They crowd out healthy blood-forming cells in the bone marrow. This can reduce the body's ability to carry oxygen, fight infection, and control bleeding. Leukemia cells may also enter the blood and spread to the lymph nodes, spleen, liver, brain, spinal cord, or other tissues.

"Acute" means the disease can progress quickly without treatment. B-ALL usually requires prompt evaluation by a hematologist-oncologist, a doctor who specializes in blood cancers. Prompt does not always mean that treatment begins the same day. The care team may need

several days to complete genetic testing, stabilize medical problems, and choose the most appropriate treatment plan.

B-ALL is not a single disease. Leukemia cells can have different chromosome and gene changes that affect treatment. One important example is the Philadelphia chromosome, also called Ph-positive ALL. This change creates the BCR::ABL1 fusion gene, which produces a protein that drives leukemia growth. Targeted medicines can block this protein.

Treatment has improved through combinations of chemotherapy, targeted therapy, antibody-based immunotherapy, stem cell transplantation, and cellular therapies. The plan depends on the leukemia's biology, response to treatment, the person's overall health, and personal goals.

Symptoms

Symptoms often result from low numbers of normal blood cells. They may develop over days or weeks, but they are not specific to leukemia.

A shortage of red blood cells, called anemia, can cause fatigue, weakness, pale skin, dizziness, shortness of breath, or a fast heartbeat. Too few healthy white blood cells can increase the risk of infection. A low platelet count can lead to easy bruising or bleeding.

Possible symptoms include:

These symptoms have many possible causes. Blood tests and other examinations are needed to determine what is happening.

Heavy bleeding, severe trouble breathing, fainting, new confusion, a seizure, or sudden weakness requires emergency care. A person who already has leukemia should follow the treatment team's instructions for fever. During periods of low infection-fighting cells, a fever may require urgent assessment even if no other symptoms are present.

- Ongoing tiredness or reduced ability to exercise
- Fever, chills, or repeated infections
- Easy bruising, nosebleeds, bleeding gums, or pinpoint red or purple spots on the skin
- Bone, joint, or abdominal discomfort
- Swollen lymph nodes, especially in the neck, underarm, or groin
- Unexplained weight loss, reduced appetite, or night sweats
- Fullness below the ribs from an enlarged liver or spleen

- Headache, vomiting, vision changes, confusion, or weakness if the nervous system is involved
- Testicular swelling or discomfort, which is uncommon but can occur

Causes and risk factors

In most adults with B-ALL, there is no clear reason the leukemia developed. It is not caused by something the person did, and there is no established lifestyle change that can reliably prevent it.

The disease develops after DNA changes occur in an immature blood-forming cell. Most of these changes are acquired during life rather than inherited from a parent. They can alter how the cell grows, matures, or repairs damage.

Factors associated with a higher risk include:

Age also affects the types of genetic changes seen in B-ALL and how well a person may tolerate intensive treatment. However, people without any known risk factor can develop the disease.

B-ALL is not contagious. Family members do not usually need leukemia screening unless a clinician suspects a rare inherited cancer-predisposition condition based on the person's medical and family history.

- Previous treatment with certain chemotherapy medicines or radiation therapy
- High levels of ionizing radiation
- Certain uncommon inherited conditions that affect chromosomes, DNA repair, or blood formation
- A previous blood or bone marrow disorder in some cases

Diagnosis

Diagnosis begins with a medical history, physical examination, and blood tests. A complete blood count measures red blood cells, white blood cells, and platelets. A blood smear allows specialists to examine the cells under a microscope. The white blood cell count may be high, normal, or low, so a normal total count does not by itself exclude leukemia.

A bone marrow aspiration and biopsy are usually needed. During this procedure, liquid marrow and a small core of bone marrow are commonly taken from the back of the hip. Local numbing

medicine is used, and some centers offer additional pain or anxiety control.

Laboratory studies confirm the cell type and guide treatment:

A lumbar puncture may be performed to test the fluid surrounding the brain and spinal cord. This procedure also allows medicine to be placed into that fluid to prevent or treat nervous system involvement.

Additional tests may assess kidney, liver, heart, and lung function. The team may order infection screening, pregnancy testing when relevant, and tissue typing for a possible donor stem cell transplant. Fertility preservation should be discussed before treatment when time and medical circumstances allow.

- Flow cytometry identifies proteins on and inside the leukemia cells. This helps distinguish B-ALL from other leukemias.
- Chromosome and gene testing looks for changes such as the Philadelphia chromosome and other features that may affect prognosis or treatment.
- Molecular testing can identify gene fusions or mutations that may be targeted by particular treatments.
- Measurable residual disease testing , or MRD testing, looks for very small numbers of leukemia cells that remain after treatment. MRD may be measured by flow cytometry, polymerase chain reaction, or newer sequencing methods.

Treatment and management

B-ALL treatment should be planned by a team experienced in adult acute leukemia. Care may be given at, or coordinated with, a specialized cancer center. Participation in a clinical trial may provide access to a carefully monitored treatment approach.

Treatment is divided into phases, although the names and details vary.

Induction treatment aims to produce remission, meaning leukemia is no longer detectable by standard examination and normal blood production begins to recover. Treatment may include chemotherapy, corticosteroids like prednisone or hydrocortisone , targeted therapy, or antibody-based immunotherapy.

Consolidation or intensification treats leukemia cells that may remain after remission. MRD results are important during this phase. Detectable MRD can mean that treatment needs to be changed or strengthened.

Maintenance treatment uses less intensive therapy over a longer period to reduce the chance of relapse. Not every modern treatment plan uses maintenance in the same way.

Therapy directed at the brain and spinal cord is required because many medicines given into a vein or by mouth do not reliably reach the fluid around the nervous system. This preventive treatment commonly includes medicine delivered by lumbar puncture. Radiation to the brain is used only in selected situations.

People with Ph-positive B-ALL receive a tyrosine kinase inhibitor, or TKI, that blocks the abnormal BCR::ABL1 protein. The TKI is combined or sequenced with other leukemia treatments. Some people with other targetable genetic changes may also qualify for targeted treatment or a clinical trial.

Immunotherapies may be used during initial treatment, for persistent MRD, or when leukemia returns. Blinatumomab helps immune cells recognize B cells carrying the CD19 protein. Inotuzumab ozogamicin carries a chemotherapy-like substance to cells with the CD22 protein. These treatments have distinct risks and require close monitoring.

CAR T-cell therapy modifies a person's own T cells so they can recognize a protein on leukemia cells, usually CD19. It may be an option for some adults with relapsed or treatment-resistant B-ALL. It can cause serious immune and neurologic reactions, so it is provided at trained centers.

An allogeneic stem cell transplant replaces blood-forming cells with cells from a donor. It can lower relapse risk for selected patients but can also cause infection, organ injury, and graft-versus-host disease, in which donor immune cells attack the recipient's tissues. The decision considers MRD, leukemia genetics, prior response, age, health, donor availability, and patient preferences.

Supportive care is part of treatment. It may include transfusions, infection prevention or treatment, medicines for nausea and pain, nutrition support, and prevention of tumor lysis syndrome. Tumor lysis syndrome occurs when many leukemia cells break down quickly and release substances that can harm the kidneys, heart, or nervous system.

Complications

B-ALL can cause severe infection, anemia, and bleeding by interfering with normal blood production. It may also involve the brain, spinal cord, liver, spleen, lymph nodes, or other tissues.

Treatment can temporarily worsen low blood counts. Other possible effects include mouth sores, nausea, diarrhea or constipation, fatigue, blood clots, nerve problems, and changes in liver, kidney, or heart function. Steroids can affect mood, sleep, blood sugar, muscles, and bones.

Some immunotherapies and CAR T-cell treatments can cause cytokine release syndrome, an intense immune response that may produce fever and low blood pressure. Neurologic effects can include confusion, difficulty speaking, tremor, or seizures. The treatment center provides specific instructions about symptoms that need immediate attention.

Long-term concerns may include infertility, bone loss, nerve damage, heart problems, secondary cancers, and emotional distress. The risks differ greatly among treatments. Relapse is also possible, including in the bone marrow or nervous system.

Follow up

During active treatment, follow-up is frequent and includes examinations, blood counts, chemistry tests, and checks for infection or organ problems. Bone marrow examinations and MRD testing are performed at key points to measure response.

After treatment, visit frequency usually decreases over time. Follow-up remains important for detecting relapse, monitoring delayed treatment effects, reviewing medicines, and supporting recovery. The care team may address vaccination, heart and bone health, fertility, sexual health, fatigue, anxiety, work, and financial concerns.

Contact the oncology team promptly for fever, new bleeding, worsening bruising, persistent vomiting, reduced urination, new rash, severe headache, confusion, weakness, or other symptoms listed in the team's instructions. Emergency services are appropriate for severe breathing difficulty, uncontrolled bleeding, a seizure, fainting, or sudden neurologic symptoms.

Routine questions about fatigue, sleep, nutrition, activity, work, fertility, or mild ongoing side effects can usually be discussed at scheduled visits unless symptoms are worsening.

Sources

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