



## What is Acute Lymphocytic Leukemia (ALL)?

**Acute lymphocytic leukemia (ALL) is a cancer of lymphocytes**, cells that live in the spongy inner mass of bone called the marrow. ALL is also called acute lymphoid leukemia or acute lymphoblastic leukemia. ALL is most common in young children and adults over age 50.

The lymph nodes are small, bean-shaped organs of the immune system. They are found in clusters in the abdomen, pelvis, underarms, and neck. Lymph nodes are part of the lymph system, which is made up of thin tubes that branch to all parts of the body. The job of the lymph system is to filter impurities from the body. The lymph system carries lymph, a colorless fluid containing white blood cells.

In ALL, non-inherited genetic changes cause the body to produce too many marrow cells called **lymphoblasts**. In normal bone marrow, lymphoblasts make lymphocytes, a kind of white blood cell found in the blood and lymph. Lymphocytes mature to help the body defend itself from infection. In people with ALL, these cells never mature.

Because blood carries cancer cells throughout the body, the cancer will spread around the body and may invade other organs, including the brain, liver and spleen. Unlike solid tumors, spread of ALL to other parts of the body does not always mean the cancer is in an advanced stage, but leukemia that has spread may require special treatment.

ALL is one of four types of leukemia. Like acute myelogenous leukemia (AML), ALL appears and progresses quickly, but begins in a different type of cell. Chronic lymphocytic leukemia and chronic myelogenous leukemia both progress more slowly.

Leukemia is either acute or chronic. In acute leukemia, the abnormal blood cells are blasts that remain very immature and cannot carry out their normal functions. The number of blasts increases rapidly, and the disease becomes worse quickly. In chronic leukemia, some blast cells are present, but in general, these cells are more mature and can carry out some of their normal functions. Also, the number of blasts increases less rapidly than in acute leukemia. As a result, chronic leukemia worsens gradually.

## Previous chemotherapy and exposure to radiation may affect the risk of developing ALL.

Possible risk factors for ALL include the following:

- Being male.
- Being white.

- Being older than 70 years of age.
- Past treatment with chemotherapy or radiation therapy.
- Exposure to atomic bomb radiation.
- Having a certain genetic disorder such as Down syndrome.

## Possible Signs of Adult ALL

The early signs of ALL may be similar to the flu or other common diseases. A doctor should be consulted if any of the following problems occur:

- Weakness or feeling tired.
- Fever.
- Easy bruising or bleeding.
- Petechiae (flat, pinpoint spots under the skin caused by bleeding).
- Shortness of breath.
- Loss of appetite or weight loss.
- Pain in the bones or stomach.
- Pain or feeling of fullness below the ribs.
- Painless lumps in the neck, underarm, stomach, or groin.

These and other symptoms may be caused by adult acute lymphoblastic leukemia or by other conditions.

## Tests Used to Detect and Diagnose Adult ALL.

The following tests and procedures may be used:

- **Physical exam and history:** An exam of the body to check general signs of health, including checking for signs of disease, such as lumps or anything else that seems unusual. A history of the patient's health habits and past illnesses and treatments will also be taken.
- **Complete blood count:** A procedure in which a sample of blood is drawn and checked for the following:
  - The number of red blood cells, white blood cells, and platelets.
  - The amount of hemoglobin (the protein that carries oxygen) in the red blood cells.
  - The portion of the blood sample made up of red blood cells.
- **Peripheral blood smear:** A procedure in which a sample of blood is checked for the presence of blast cells, number and kinds of white blood cells, the number of platelets, and changes in the shape of blood cells.
- **Bone marrow biopsy and aspiration:** The removal of a small piece of bone and bone marrow by inserting a needle into the hipbone or breastbone. A pathologist views the samples under a microscope to look for abnormal cells.
- **Cytogenetic analysis:** A test in which the cells in a sample of blood or bone marrow are looked at under a microscope to find out if there are certain changes in the chromosomes in the lymphocytes. For example, sometimes in ALL, part of one chromosome is moved to another chromosome. This is called the Philadelphia chromosome.

- **Immunophenotyping:** A test in which the cells in a sample of blood or bone marrow are looked at under a microscope to find out if malignant (cancerous) lymphocytes began from the B lymphocytes or the T lymphocytes.

## Factors Affecting Prognosis and Treatment Options.

The prognosis (chance of recovery) and treatment options depend on the following:

- The age of the patient.
- Whether the cancer has spread to the brain or spinal cord.
- Whether the Philadelphia chromosome is present.
- Whether the cancer has been treated before or has recurred (come back).

As we well know, there are many kinds of cancer; unfortunately they all come about because of the out-of-control growth of abnormal cells.

## Healthy Cells vs. Cancer Cells

Healthy cells are like a cat. They need structure to determine the size of bones and shape of the body, tail and whiskers. The DNA in genes and chromosomes determine this. They need energy to play and prowl and sustain life. This is derived from chemicals in food. Cats need a system to deliver chemicals (food nutrients like amino acids, carbohydrates, fats, vitamins and minerals) to all parts of their body. These are the blood vessels. Growth factors take a kitten into a lazy old cat, all the while helping it to function normally.

The body and its cells are mostly made up of protein. The building blocks of proteins are substances called amino acids that in the form of enzymes and hormones literally control every chemical reaction within the cells. When these are modified, different messages are sent to a complex control system that can alter their function. There are twenty different kinds of amino acids that are essential to life. Twelve of these can be synthesized within the body however; eight must be supplied by the daily diet

Structure	
Normal Cells	Cancer Cells
DNA in genes and chromosomes go about their business in a normal way.	Cancer cells develop a different DNA or gene structure or acquire abnormal numbers of chromosomes.
Cells divide in an orderly way to produce more cells only when the body needs them.	Cells continue to be created without control or order. If not needed, a mass of tissue is formed which is called a tumor.
Energy	
Normal Cells	Cancer Cells
Cells derive 70% of their energy from a system called the "Krebs Cycle."	Cells have a defective "Krebs Cycle" and derive little or no energy from it.
Cells derive only 20% of their energy	Cancer cells derive almost all their

from a system called “Glycolosis.”	energy from “Glycolosis.”
Cells derive most of their energy with the use of oxygen.	Cells derive most of their energy in the absence of oxygen.
<b>Blood Vessels</b>	
<b>Normal Cells</b>	<b>Cancer Cells</b>
Cells have a built-in blood vessel system.	Cells do not have a built-in blood vessel system. They require more of certain amino acids to grow.
<b>Growth Factors</b>	
<b>Normal Cells</b>	<b>Cancer Cells</b>
While similar to cancer cells, the amount of them is more in balance to produce a more normal level of activity.	These cells have over produced, require more chemicals (food) and are over active.
<b>Functions</b>	
<b>Normal Cells</b>	<b>Cancer Cells</b>
The enzymes and hormones go about business in a normal balanced manner.	The enzymes and hormones are either over active or under active.
<b>Tumors are Different</b>	
<b>Benign</b>	<b>Malignant</b>
Benign tumors are not cancerous. They do not invade nearby tissues nor spread to other parts of the body. They can be removed and are not a threat to life.	Malignant tumors are cancerous. They can invade and damage nearby tissues and organs and they can break away and enter the blood stream to form new tumors in other parts of the body. The spread of cancer is called metastasis.

**Once adult ALL has been diagnosed, tests are done to find out if the cancer has spread to the central nervous system (brain and spinal cord) or to other parts of the body.**

The extent or spread of cancer is usually described as stages. It is important to know whether the leukemia has spread outside the blood and bone marrow in order to plan treatment. The following tests and procedures may be used to determine if the leukemia has spread:

- **Chest x-ray**: An x-ray of the organs and bones inside the chest. An x-ray is a type of energy beam that can go through the body and onto film, making a picture of areas inside the body.
- **Lumbar puncture**: A procedure used to collect cerebrospinal fluid from the spinal column. This is done by placing a needle into the spinal column. This procedure is also called an LP or spinal tap.
- **Ultrasound**: A procedure in which high-energy sound waves (ultrasound) are bounced off internal tissues or organs in the abdomen and make echoes. The echoes form a picture of body tissues called a sonogram.
- **CT scan (CAT scan)**: A procedure that makes a series of detailed pictures of the abdomen, taken from different angles. The pictures are made by a computer

linked to an x-ray machine. A dye may be injected into a vein or swallowed to help the organs or tissues show up more clearly. This procedure is also called computed tomography, computerized tomography, or computerized axial tomography.

## There is no standard staging system for adult ALL.

The disease is classified as untreated, in remission, or recurrent.

### Untreated adult ALL

The ALL is newly diagnosed and has not been treated except to relieve symptoms such as fever, bleeding or pain.

- The complete blood count is abnormal.
- There are more than 5% blasts (leukemia cells) in the bone marrow.
- There are signs and symptoms of leukemia.

### Adult ALL in remission

The ALL has been treated.

- The complete blood count is normal.
- There are less than 5% blasts (leukemia cells) in the bone marrow.
- There are no signs or symptoms of leukemia in the brain and spinal cord or elsewhere in the body.

## Different Types of Treatment for Patients with Adult ALL.

Different types of treatment are available for patients with adult acute lymphoblastic leukemia (ALL). Some treatments are standard (the currently used treatment), and some are being tested in clinical trials. A treatment clinical trial is a research study meant to help improve current treatments or obtain information on new treatments for patients with cancer. When clinical trials show that a new treatment is better than the "standard" treatment, the new treatment may become the standard treatment.

### The treatment of adult ALL usually has 2 phases.

The treatment of adult ALL is done in phases:

- **Remission induction therapy**: This is the first phase of treatment. Its purpose is to kill the leukemia cells in the blood and bone marrow. This puts the leukemia into remission.
- **Maintenance therapy**: This is the second phase of treatment. It begins once the leukemia is in remission. The purpose of maintenance therapy is to kill any

remaining leukemia cells that may not be active but could begin to regrow and cause a relapse. This phase is also called remission continuation therapy.

Treatment called central nervous system (CNS) sanctuary therapy is usually given during each phase of therapy. Because chemotherapy that is given by mouth or injected into a vein may not reach leukemia cells in the CNS (brain and spinal cord), the cells are able to find "sanctuary" (hide) in the CNS. Intrathecal chemotherapy and radiation therapy are able to reach leukemia cells in the CNS and are given to kill the leukemia cells and prevent the cancer from recurring (coming back). CNS sanctuary therapy is also called CNS prophylaxis.

## Types of standard treatment are used:

### 1. Chemotherapy

Chemotherapy is a cancer treatment that uses drugs to stop the growth of cancer cells, either by killing the cells or by stopping the cells from dividing. When chemotherapy is taken by mouth or injected into a vein or muscle, the drugs enter the bloodstream and can reach cancer cells throughout the body (systemic chemotherapy). When chemotherapy is placed directly into the spinal column, a body cavity such as the abdomen, or an organ, the drugs mainly affect cancer cells in those areas. Combination chemotherapy is treatment using more than one anticancer drug. The way the chemotherapy is given depends on the type and stage of the cancer being treated.

Intrathecal chemotherapy may be used to treat adult ALL that has spread, or may spread, to the brain and spinal cord. When used to prevent cancer from spreading to the brain and spinal cord, it is called central nervous system (CNS) sanctuary therapy or CNS prophylaxis. Intrathecal chemotherapy is given in addition to chemotherapy by mouth or vein.

### 2. Radiation therapy

Radiation therapy is a cancer treatment that uses high-energy x-rays or other types of radiation to kill cancer cells. There are two types of radiation therapy. External radiation therapy uses a machine outside the body to send radiation toward the cancer. Internal radiation therapy uses a radioactive substance sealed in needles, seeds, wires, or catheters that are placed directly into or near the cancer. External radiation therapy may be used to treat adult ALL that has spread, or may spread, to the brain and spinal cord. When used this way, it is called central nervous system (CNS) sanctuary therapy or CNS prophylaxis.

### 3. High-dose chemotherapy with stem cell transplantation

Stem cell transplantation is a method of giving chemotherapy and replacing blood-forming cells destroyed by the cancer treatment. Stem cells (immature blood cells) are removed from the blood or bone marrow of a donor and are frozen for storage. After the chemotherapy is completed, the stored stem cells are thawed and given back to the

patient through an infusion. These reinfused stem cells grow into (and restore) the body's blood cells.

### **Untreated Adult Acute Lymphoblastic Leukemia**

Standard treatment of adult acute lymphoblastic leukemia (ALL) during the remission induction phase includes the following:

- Combination chemotherapy.
- CNS prophylaxis therapy including chemotherapy (intrathecal and/or systemic) with or without radiation therapy to the brain.

### **Adult Acute Lymphoblastic Leukemia in Remission**

Standard treatment of adult ALL during the maintenance phase includes the following:

- Combination chemotherapy.
- High-dose chemotherapy with stem cell transplantation.
- CNS prophylaxis therapy including chemotherapy (intrathecal and/or systemic) with or without radiation therapy to the brain.

### **Recurrent Adult Acute Lymphoblastic Leukemia**

Standard treatment of recurrent adult ALL may include the following:

- Combination chemotherapy followed by stem cell transplantation.
- Low-dose radiation therapy as palliative care to relieve symptoms and improve the quality of life.

Some of the treatments being studied in clinical trials for recurrent adult ALL include the following:

- A clinical trial of stem cell transplantation using the patient's own stem cells.
- A clinical trial of biologic therapy.
- A clinical trial of new chemotherapy drugs.

## **What are the Side Effects of the Treatment for Leukemia?**

It is hard to limit the effects of therapy so that only leukemia cells are destroyed. Because treatment also damages healthy cells and tissues, it causes side effects.

The side effects of cancer treatment vary. They depend mainly on the type and extent of the treatment. Also, each person reacts differently. Side effects may even be different from one treatment to the next. Attempts are made to plan the patient's therapy to keep side effects to a minimum.

Doctors and nurses can explain the side effects of treatment and can suggest medicine,

diet changes, or other ways to deal with them. The National Cancer Institute booklets **Chemotherapy and You** and **Radiation Therapy and You** also have helpful information about cancer treatment and coping with side effects.

## **Chemotherapy**

Side effects of chemotherapy depend mainly on the drugs the patient receives. In addition, as with other types of treatment, side effects may vary from person to person. Generally, anticancer drugs affect dividing cells. Cancer cells divide more often than healthy cells and are more likely to be affected by chemotherapy. Still, some healthy cells also may be damaged. Healthy cells that divide often, including blood cells, cells in hair roots, and cells in the digestive tract, are likely to be damaged. When chemotherapy affects healthy cells, it can lower patients' resistance to infection, and patients may have less energy and bruise or bleed easily. They may lose their hair. They can also have nausea, vomiting, and mouth sores. Most side effects go away gradually during the recover periods between treatments or after treatment stops.

Some anticancer drugs can affect a patient's fertility. Women's periods may become irregular or stop, and women may have symptoms of menopause, such as hot flashes and vaginal dryness. Men may stop producing sperm. Because these changes can be permanent, some men choose to have their sperm frozen and stored. Most children treated for leukemia appear to have normal fertility when they grow up. However, depending on the drugs and doses used and on the age of the patient, some boys and girls may not be able to have children when they mature.

## **Radiation Therapy**

Patients receiving radiation therapy can become very tired. Resting is important, but doctors usually suggest that patients remain as active as they can.

When radiation is directed to the head, patients often lose their hair. Radiation can cause the scalp or the skin in the treated area to become red, dry, tender, and itchy. Patients will be shown how to keep the skin clean. They should not use any lotion or cream on the treated area without consulting with the doctor. Radiation therapy can also cause nausea, vomiting, and loss of appetite. These side effects are temporary, and doctors and nurses can often suggest ways to control them until the treatment is over.

However, some side effects may be lasting. Children (especially young ones) who receive radiation to the brain may develop problems with learning and coordination. For this reason, doctors use the lowest possible doses of radiation, and they give this treatment only to children who cannot be treated successfully with chemotherapy alone.

Also, radiation to the testicles is likely to affect both fertility and hormone production. Most boys who have this form of treatment are not able to have children later on. Some may need to take hormones.

## **Bone Marrow Transplantation**

Patients who have a bone marrow transplant face an increased risk of infection, bleeding, and other side effects of the large doses of chemotherapy and radiation they

receive. In addition, graft- versus-host disease (GVHD) may occur in patients who receive bone marrow from a donor. In GVHD, the donated marrow reacts against the patient's tissues (most often the liver, the skin, and the digestive tract). GVHD can be mild or very severe. It can occur any time after the transplant (even years later). Drugs may be given to reduce the risk of GVHD and to treat the problem if it occurs.

### **Nutrition for Cancer Patients**

Many cancer patients find it hard to eat well. They may lose their appetite. In addition, the common side effects of therapy, such as nausea, vomiting, or mouth sores, can make eating difficult. For some patients, foods taste different. Also, people may not feel like eating when they are uncomfortable or tired.

### **What happens after treatment for leukemia?**

Regular follow-up exams are very important after treatment for leukemia. The doctor will continue to check the patient closely to be sure that the cancer has not returned. Checkups usually include exams of the blood, bone marrow, and cerebrospinal fluid. From time to time, the doctor does a complete physical exam. Cancer treatment may cause side effects many years later. For this reason, patients should continue to have regular checkups and should also report health changes or problems to their doctor as soon as they appear.

**Source: A.P. John Institute for Cancer Research**

**When considering any type of complementary cancer treatment or alternative cancer treatment, always consult with your physician first, as possible interactions could reduce your treatment protocol's efficacy.**