

Acute Lymphoblastic Leukemia in Children

Key Points

- Acute lymphoblastic leukemia (ALL) is a cancer of the white blood cells, the cells in the body that normally fight infections.
- In ALL, the abnormal cells may collect in the brain or spinal cord, also called the central nervous system (CNS).
- In cancers such as leukemia that appear throughout the body during their earliest stages, screening does not appear to be useful. Rather, children with any symptoms that suggest the possibility of ALL should be seen by their physician.
- Although leukemia cells from different children with ALL often look very similar under the microscope, there are actually many distinctive subtypes of ALL.
- With the exception of prenatal exposure to X-rays and specific genetic syndromes, such as Down syndrome, little is known about the causes of and risk factors for childhood ALL.

1. What is acute lymphoblastic leukemia (ALL)?

Acute lymphoblastic leukemia (ALL) is a cancer of the white blood cells, the cells in the body that normally fight infections. There are two main types of white blood cells—lymphoid cells and myeloid cells. ALL affects lymphoid cells.

Leukemia cells are abnormal cells that cannot do what normal blood cells do. The abnormal cells are immature white blood cells that cannot help the body fight infections. For this reason, children with ALL often get infections and have fevers.

ALL is also called acute lymphocytic leukemia. It is the most common leukemia in children.

2. What are the symptoms of ALL?

Like all blood cells, leukemia cells travel through the body. Depending on the number of abnormal cells and where these cells collect, patients with leukemia may have a number of symptoms. Children with ALL frequently have low amounts of healthy red blood cells and platelets. As a result, there are not enough red blood cells to carry oxygen through the body. With this condition, called anemia, patients may look pale and feel weak and tired. When there are not enough platelets, patients bleed and bruise easily.

Some of the common symptoms of ALL include:

- fever
- fatigue
- frequent infections
- swollen or tender lymph nodes, liver, or spleen
- paleness or pallor
- easy bleeding or bruising
- tiny red spots (called petechiae) under the skin
- bone or joint pain



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In ALL, the abnormal cells may collect in the brain or spinal cord, also called the *central* nervous system (CNS). The result may be headaches with or without vomiting, although most children with the disease do not have these symptoms. Leukemia cells also can collect in the testicles and cause swelling.

3. Is there a screening test for ALL?

No. Screening is a means of detecting disease in people who have no symptoms. As described in the National Cancer Institute's Cancer Screening Overview (PDQ®) (<http://www.cancer.gov/cancertopics/pdq/screening/overview/healthprofessional>), two requirements must be met for screening to be useful:

(1) There must be a test or procedure that will detect cancers earlier than if the cancer were detected as a result of the development of symptoms, and

(2) There must be evidence that treatment initiated earlier as a consequence of screening results in an improved outcome.

These two requirements have not been met for childhood ALL.

In cancers such as leukemia that appear throughout the body during their earliest stages, screening does not appear to be useful. Rather, children with any symptoms that suggest the possibility of ALL should be seen by their physician. The physician can then examine the child and determine if further testing is needed.

4. How is ALL diagnosed?

If a child has symptoms that suggest leukemia, the physician may first order blood tests. A sample of blood is examined to determine the number of normal blood cells, to see what the cells look like, and to find out if any leukemia cells are present in the blood. For a definitive diagnosis of ALL, a doctor who specializes in leukemia examines a sample of bone marrow under a microscope. The sample is obtained by a procedure called bone marrow aspiration. In this procedure, the doctor inserts a needle into a large bone, usually the hip, and removes a small amount of liquid bone marrow for examination.

If leukemia cells are found in the bone marrow sample, the patient's doctor orders other tests to find out the extent of the disease. For example, a spinal tap, which is also called a lumbar puncture, checks for leukemia cells in the cerebrospinal fluid—the fluid that fills the spaces in and around the brain and spinal cord.

5. Are there different types of ALL?

Although leukemia cells from different children with ALL often look very similar under the microscope, there are actually many distinctive subtypes of ALL. Most cases of leukemia are associated with changes in genes and chromosomes in the cancerous white blood cells. The various subtypes of ALL can be identified using special laboratory tests that look for specific changes in genes and chromosomes. It is increasingly important for doctors treating children with ALL to determine their patients' subtype of ALL, as some treatments work better for some subtypes than for others.

6. How common is ALL?

Cancer in children and adolescents is rare. But, ALL is the most common cancer in children, representing 23 percent of cancer diagnoses among children younger than 15 years of age. It occurs in about one of every 29,000 children in the United States each year.

7. What causes ALL?

With the exception of prenatal exposure to X-rays and specific genetic syndromes, such as Down syndrome, little is known about the causes of and risk factors for childhood ALL.

Scientists know that ALL in children occurs slightly more often in boys than in girls and in white children more often than in black children. However, they cannot explain why one person gets leukemia and another does not.

8. What treatments are available for the disease?

There are treatments for all children with ALL (see <http://www.cancer.gov/cancertopics/pdq/treatment/childALL/healthprofessional>). The primary treatment for ALL is chemotherapy. The specific drugs used for chemotherapy are different for the various subtypes of ALL and are not the same for all patients.

Treatment for children with ALL is complex and involves multiple drugs given in precise schedules over a period of two to three years. Because of this, children with the disease should be treated by doctors with experience and expertise in the treatment of childhood leukemias.

Many children with ALL participate in clinical trials. These studies test a new drug or a new combination of drugs, often comparing them to the current standard treatment. A participant will usually be assigned to the standard group or the new group by chance, a process called randomization. It is not known at the start of the trial whether the new treatment is better than, the same as, or worse than the standard treatment. Clinical trials for children with ALL often enroll large numbers of children and are conducted at children's cancer centers nationwide. Much of the success in curing children with ALL is the result of better treatments that were identified in such clinical trials. Still, doctors are doing clinical trials to try to improve ALL treatments and reduce side effects.

9. What is the survival rate for children with ALL?

The improvement in survival for children with ALL over the past 35 years is one of the great success stories of cancer treatment. In the 1960s, less than 5 percent of children with ALL survived for more than five years. Today, about 85 percent of children with ALL live five years or more.

10. What factors determine successful treatment for children with ALL?

The chance of survival for children with ALL is dependent upon a number of factors. The most important factor is receiving optimal care at a center experienced in the treatment of children with ALL. Even with optimal care, some children with ALL are much more difficult to treat successfully than others.

In the past, factors such as age and white blood cell count at diagnosis were commonly used to predict outcome. For example, children 1 to 9 years old have higher survival rates than do infants or older children. However, factors such as age and white blood cell count at diagnosis are, at best, crude predictors of outcome.

It is now clear that the patient's subtype of ALL has a powerful impact on survival. For example, infants commonly have a subtype of ALL in which a specific gene is modified. This subtype of ALL is very hard to treat successfully and only a minority of infants with this subtype of ALL survive with current therapy. Other subtypes of ALL in which different genes are modified occur more commonly in older children and have a much more favorable outcome.

It is now common practice for the leukemia cells of children with ALL to be tested for the gene modifications. The type of treatment is then based on the particular change seen in the leukemia cells.

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Related NCI materials and Web pages:

- National Cancer Institute Fact Sheet 1.21, *Care for Children and Adolescents With Cancer* (<http://www.cancer.gov/cancertopics/factsheet/NCI/children-adolescents>)
- National Cancer Institute Fact Sheet 6.40, *Childhood Cancers: Questions and Answers* (<http://www.cancer.gov/cancertopics/factsheet/Sites-Types/childhood>)
- *Taking Part in Cancer Treatment Research Studies* (<http://www.cancer.gov/clinicaltrials/Taking-Part-in-Cancer-Treatment-Research-Studies>)
- *What You Need To Know About™ Leukemia* (<http://www.cancer.gov/cancertopics/wyntk/leukemia>)
- Childhood Cancers Home Page (<http://www.cancer.gov/cancertopics/types/childhoodcancers>)
- Leukemia Home Page (<http://www.cancer.gov/cancertopics/types/leukemia>)

How can we help?

We offer comprehensive research-based information for patients and their families, health professionals, cancer researchers, advocates, and the public.

- **Call** NCI's Cancer Information Service at 1-800-4-CANCER (1-800-422-6237)
- **Visit** us at <http://www.cancer.gov> or <http://www.cancer.gov/espanol>
- **Chat** using LiveHelp, NCI's instant messaging service, at <http://www.cancer.gov/livehelp>
- **E-mail** us at cancergovstaff@mail.nih.gov
- **Order** publications at <http://www.cancer.gov/publications> or by calling 1-800-4-CANCER
- **Get help** with quitting smoking at 1-877-44U-QUIT (1-877-448-7848)

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