



Health & Wellness Resource Center

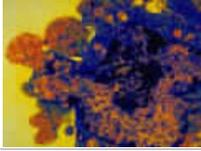
Leukemias, acute

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	<p>An enhanced scanning electron microscopy (SEM) image of acute myelogenous leukemia cells.</p>
<p><i>(Photograph by Robert Becker, Ph.D., Custom Medical Stock Photo. Reproduced by permission.)</i></p>	

Leukemias, acute	
	<p>An enhanced transmission electron microscopy (TEM) image of acute myelogenous leukemia cells.</p>
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Definition

Leukemia is a cancer that starts in the organs that make blood, namely the bone marrow and the lymph system. Depending on their characteristics, leukemias can be divided into two broad types. Acute leukemias are the rapidly progressing leukemias, while the chronic leukemias progress more slowly. The vast majority of the childhood leukemias are of the acute form.

Description

The cells that make up blood are produced in the bone marrow and the lymph system. The bone marrow is the spongy tissue found in the large bones of the body. The lymph system includes the spleen (an organ in the upper abdomen), the thymus (a small organ beneath the breastbone), and the tonsils (an organ in the throat). In addition, the lymph vessels (tiny tubes that branch like blood vessels into all parts of the body) and lymph nodes (pea-shaped organs that are found along the network of lymph vessels) are also part of the lymph system. The lymph is a milky fluid that contains cells. Clusters of lymph nodes are found in the neck, underarm, pelvis, abdomen, and chest.

The cells found in the blood are the red blood cells (RBCs), which carry oxygen and other materials to all tissues of the body; white blood cells (WBCs) that fight infection; and the platelets, which play a part in the clotting of the blood. The white blood cells can be further subdivided into three main types: granulocytes, monocytes, and lymphocytes.

The granulocytes, as their name suggests, have particles (granules) inside them. These granules contain special proteins (enzymes) and several other substances that can break down chemicals and destroy microorganisms, such as bacteria. Monocytes are the second type of white blood cell. They are also important in defending the body against pathogens.

The lymphocytes form the third type of white blood cell. There are two main types of lymphocytes: T lymphocytes and B lymphocytes. They have different functions within the immune system. The B cells protect the body by making "antibodies." Antibodies are proteins that can attach to the surfaces of bacteria and viruses. This "attachment" sends signals to many other cell types to come and destroy the antibody-coated organism. The T cells protect the body against viruses. When a virus enters a cell, it produces certain proteins that are projected onto the surface of the infected cell. The T cells recognize these proteins and make certain chemicals that are capable of destroying the virus-infected cells. In addition, the T cells can destroy some types of cancer cells.

The bone marrow makes stem cells, which are the precursors of the different blood cells. These stem cells mature through stages into either RBCs, WBCs, or platelets. In acute leukemias, the maturation process of the white blood cells is interrupted. The immature cells (or "blasts") proliferate rapidly and begin to accumulate in various organs and tissues, thereby affecting their normal function. This uncontrolled proliferation of the immature cells in the bone marrow affects the production of the normal red blood cells and platelets as well.

Acute leukemias are of two types: acute lymphocytic leukemia and acute myelogenous leukemia. Different types of white blood cells are involved in the two leukemias. In acute lymphocytic leukemia (ALL), it is the T or the B lymphocytes that become cancerous. The B cell leukemias are more common than T cell leukemias. Acute myelogenous leukemia, also known as acute nonlymphocytic leukemia (ANLL), is a cancer of the monocytes and/or granulocytes.

Leukemias account for 2% of all cancers. Because leukemia is the most common form of childhood cancer, it is often regarded as a disease of childhood. However, leukemias affect nine times as many adults as children. Half of the cases occur in people who are 60 years of age or older. The incidence of acute and chronic leukemias is about the same. According to the estimates of the American Cancer Society (ACS), approximately 29,000 new cases of leukemia will be diagnosed in 1998.

Causes & symptoms

Leukemia strikes both sexes and all ages. The human T-cell leukemia virus (HTLV-I) is believed to be the causative agent for some kinds of leukemias. However, the cause of most leukemias is not known. Acute lymphoid leukemia (ALL) is more common among Caucasians than among African-Americans, while acute myeloid leukemia (AML) affects both races equally. The incidence of acute leukemia is slightly higher among men than women. People with Jewish ancestry have a higher likelihood of getting leukemia. A higher incidence of leukemia has also been observed among persons with Down syndrome and some other genetic abnormalities.

Exposure to ionizing radiation and to certain organic chemicals, such as benzene, is believed to increase the risk of getting leukemia. Having a history of diseases that damage the bone marrow, such as aplastic anemia, or a history of cancers of the lymphatic system puts people at a high risk for developing acute leukemias. Similarly, the use of anticancer medications, immunosuppressants, and the antibiotic chloramphenicol are also considered risk factors for developing acute leukemias.

The symptoms of leukemia are generally vague and non-specific. A patient may experience all or some of the following symptoms:

- Weakness or chronic fatigue
- Fever of unknown origin
- Weight loss that is not due to dieting or exercise
- Frequent bacterial or viral infections
- Headaches
- Skin rash
- Non-specific bone pain
- Easy bruising

- Bleeding from gums or nose
- Blood in urine or stools
- Enlarged lymph nodes and/or spleen
- Abdominal fullness.

Diagnosis

Like all cancers, acute leukemias are best treated when found early. There are no screening tests available.

If the doctor has reason to suspect leukemia, he or she will conduct a very thorough physical examination to look for enlarged lymph nodes in the neck, underarm, and pelvic region. Swollen gums, enlarged liver or spleen, bruises, or pinpoint red rashes all over the body are some of the signs of leukemia. Urine and blood tests may be ordered to check for microscopic amounts of blood in the urine and to obtain a complete differential blood count. This count will give the numbers and percentages of the different cells found in the blood. An abnormal blood test might suggest leukemia; however, the diagnosis has to be confirmed by more specific tests.

The doctor may perform a bone marrow biopsy to confirm the diagnosis of leukemia. During the biopsy, a cylindrical piece of bone and marrow is removed. The tissue is generally taken out of the hipbone. These samples are sent to the laboratory for examination. In addition to diagnosis, the biopsy is also repeated during the treatment phase of the disease to see if the leukemia is responding to therapy.

A spinal tap (lumbar puncture) is another procedure that the doctor may order to diagnose leukemia. In this procedure, a small needle is inserted into the spinal cavity in the lower back to withdraw some cerebrospinal fluid and to look for leukemic cells.

Standard imaging tests, such as x rays, computed tomography scans (CT scans), and magnetic resonance imaging (MRI) may be used to check whether the leukemic cells have invaded other areas of the body, such as the bones, chest, kidneys, abdomen, or brain. A gallium scan or bone scan is a test in which a radioactive chemical is injected into the body. This chemical accumulates in the areas of cancer or infection, allowing them to be viewed with a special camera.

Treatment

There are two phases of treatment for leukemia. The first phase is called "induction therapy." As the name suggests, during this phase, the main aim of the treatment is to reduce the number of leukemic cells as far as possible and induce a remission in the patient. Once the patient shows no obvious signs of leukemia (no leukemic cells are detected in blood tests and bone marrow biopsies), the patient is said to be in remission. The second phase of treatment is then initiated. This is called continuation or maintenance therapy, and the aim in this case is to kill any remaining cells and to maintain the remission for as long as possible.

Chemotherapy is the use of drugs to kill cancer cells. It is usually the treatment of choice and is used to relieve symptoms and achieve long-term remission of the disease. Generally, combination chemotherapy, in which multiple drugs are used, is more efficient than using a single drug for the treatment. Some drugs may be administered intravenously through a vein in the arm; others may be given by mouth in the form of pills. If the cancer cells have invaded the brain, then chemotherapeutic drugs may be put into the fluid that surrounds the brain through a needle in the brain or back. This is known as intrathecal chemotherapy.

Because leukemia cells can spread to all the organs via the blood stream and the lymph vessels, surgery is not considered an option for treating leukemias.

Radiation therapy, which involves the use of x rays or other high-energy rays to kill cancer cells and shrink tumors, may be used in some cases. For acute leukemias, the source of radiation is usually outside the body (external radiation therapy). If the leukemic cells have spread to the brain, radiation therapy can be given to the brain.

Bone marrow transplantation is a process in which the patient's diseased bone marrow is replaced with healthy marrow. There are two ways of doing a bone marrow transplant. In an allogeneic bone marrow transplant, healthy marrow is taken from a donor whose tissue is either the same as or very closely resembles the patient's tissues. The

donor may be a twin, a brother or sister (sibling), or a person who is not related at all. First, the patient's bone marrow is destroyed with very high doses of chemotherapy and radiation therapy. Healthy marrow from the donor is then given to the patient through a needle in a vein to replace the destroyed marrow.

In the second type of bone marrow transplant, called an autologous bone marrow transplant, some of the patient's own marrow is taken out and treated with a combination of anticancer drugs to kill all the abnormal cells. This marrow is then frozen to save it. The marrow remaining in the patient's body is destroyed with high-dose chemotherapy and radiation therapy. The marrow that was frozen is then thawed and given back to the patient through a needle in a vein. This mode of bone marrow transplant is currently being investigated in clinical trials.

Biological therapy or immunotherapy is a mode of treatment in which the body's own immune system is harnessed to fight the cancer. Substances that are routinely made by the immune system (such as growth factors, hormones, and disease-fighting proteins) are either synthetically made in a laboratory or their effectiveness is boosted and they are then put back into the patient's body. This treatment mode is also being investigated in clinical trials all over the country at major cancer centers.

Prognosis

Like all cancers, the prognosis for leukemia depends on the patient's age and general health. According to statistics, more than 60% of the patients with leukemia survive for at least a year after diagnosis. Acute myelocytic leukemia (AML) has a poorer prognosis rate than acute lymphocytic leukemias (ALL) and the chronic leukemias. In the last 15 to 20 years, the five-year survival rate for patients with ALL has increased from 38% to 57%.

Interestingly enough, since most childhood leukemias are of the ALL type, chemotherapy has been highly successful in their treatment. This is because chemotherapeutic drugs are most effective against actively growing cells. Due to the new combinations of anticancer drugs being used, the survival rates among children with ALL have improved dramatically. Eighty percent of the children diagnosed with ALL now survive for five years or more, as compared to 50% in the late 1970s.

Prevention

Most cancers can be prevented by changes in lifestyle or diet, which will reduce the risk factors. However, in leukemias, there are no such known risk factors. Therefore, at the present time, no way is known to prevent leukemias from developing. People who are at an increased risk for developing leukemia because of proven exposure to ionizing radiation or exposure to the toxic liquid benzene, and people with Down syndrome, should undergo periodic medical checkups.

For More Information

Books

- Berkow, Robert, et al., eds. *Merck Manual of Diagnosis and Therapy*, 16th ed. Merck Research Laboratories, 1992.
- Dollinger, Malin. *Everyone's Guide to Cancer Therapy*. Somerville House Books Limited, 1994.
- Morra, Marion E. *Choices*. Avon Books, 1994.
- Murphy, Gerald P. *Informed Decisions: The Complete Book of Cancer Diagnosis, Treatment and Recovery*. American Cancer Society, 1997.

Organizations

- American Cancer Society. 1599 Clifton Road, N.E., Atlanta, Georgia 30329. (800) 227-2345. <http://www.cancer.org>.
- Cancer Research Institute. 681 Fifth Avenue, New York, N.Y. 10022. (800) 992-2623.

<http://www.cancerresearch.org>.

- Leukemia Society of America, Inc. 600 Third Avenue, New York, NY 10016. (800) 955-4572.
<http://www.leukemia.org>.
- National Cancer Institute. 9000 Rockville Pike, Building 31, Room 10A16, Bethesda, Maryland, 20892. (800) 422-6237. <http://wwwicic.nci.nih.gov>.
- Oncolink. University of Pennsylvania Cancer Center. <http://cancer.med.upenn.edu>

Key Terms

Term	Definition
<i>Antibodies</i>	Proteins made by the B lymphocytes in response to the presence of infectious agents, such as bacteria or viruses, in the body.
<i>Biopsy</i>	The surgical removal and microscopic examination of living tissue for diagnostic purposes.
<i>Chemotherapy</i>	Treatment with drugs that act against cancer.
<i>Computerized tomography (CT) scan</i>	A series of x rays put together by a computer in order to form detailed pictures of areas inside the body.
<i>Cytokines</i>	Chemicals made by the cells that act on other cells to stimulate or inhibit their function. Cytokines that stimulate growth are called "growth factors."
<i>Immunotherapy</i>	Treatment of cancer by stimulating the body's immune defense system.
<i>Lumbar puncture</i>	A procedure in which the doctor inserts a small needle into the spinal cavity in the lower back to withdraw some spinal fluid for testing. Also known as a "spinal tap."
<i>Magnetic resonance imaging (MRI)</i>	A medical procedure using a magnet linked to a computer to picture areas inside the body.
<i>Maturation</i>	The process by which stem cells transform from immature cells without a specific function into a particular type of blood cell with defined functions.
<i>Radiation therapy</i>	Treatment using high-energy radiation from x-ray machines, cobalt, radium, or other sources.
<i>Remission</i>	A disappearance of a disease as a result of treatment. Complete remission means that all disease is gone. Partial remission means that the disease is significantly improved by treatment, but residual traces of the disease are still present.

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