Cancer

Leukemia

What is leukemia?

Leukemia is a cancer that affects blood-forming stem cells or blood cells, usually the white blood cells that carry out immune responses. Abnormal cells can grow out of control in the bone marrow and enter the bloodstream before they are fully developed, crowding out mature, functional blood cells. The resulting shortage of functional cells can lead to increased susceptibility to infection, anemia and impaired blood clotting. Leukemia can often be put into remission and sometimes it can be cured. But rapidly progressing acute leukemia requires prompt treatment.

Leukemia is classified according to the type of cells affected, whether it is acute (fast-progressing) or chronic (slow-growing) and whether it affects adults or children. Acute anemia involves overgrowth of very immature blood cell precursors (known as blasts) that cannot carry out normal functions such as fighting infection. Chronic leukemia involves overproduction of more mature but abnormal blood cells that are only partially functional. There are four major types of leukemia:

- Acute lymphocytic or lymphoblastic leukemia (ALL)
- Chronic lymphocytic leukemia (CLL)
- Acute myeloid leukemia (AML)
- Chronic myeloid leukemia (CML)

Acute lymphoblastic leukemia involves overgrowth of precursor cells known as lymphoblasts in the bone marrow, which impairs the production of normal bloods cells. Chronic lymphocytic leukemia involves overproduction of abnormal B cells, T cells or natural killer cells. In some cases, CLL can transform into a type of lymphoma.

Myeloid or myelogenous leukemia involves overgrowth of precursor cells known as myeloblasts, which give rise to neutrophils and other granulocyte white blood cells. AML may also involve overproduction of abnormal red blood cells or platelets.

Hairy cell leukemia is an uncommon form of leukemia characterized by overgrowth of lymphocytes that have a “hairy” appearance. Chronic myelomonocytic leukemia involves overproduction of monocytes, another type of white blood cell.

Who gets leukemia?

About 62,100 people develop leukemia and 24,500 people die from it annually in the United States, according to the American Cancer Society. This includes about 6,000 cases of ALL (1,400 deaths), 21,400 cases of AML (10,600 deaths), 20,100 cases of CLL (4,600 deaths) and 8,900 cases of CML (1,100 deaths).

AML and CLL are the most common types of leukemia in older adults. Most types of leukemia usually develop in middle age or later, and men are more likely to get it than women. ALL is one of the most common childhood cancers. Children and adolescents account for about 60 percent of people with ALL, but adults are harder to treat and account for 80 percent of ALL deaths.

What are the risk factors for leukemia?

Risk factors for leukemia include family history, certain genetic disorders or gene mutations, smoking and exposure to radiation or industrial chemicals. People treated with radiation or chemotherapy for other types of cancers are at higher risk for developing leukemia.

What are the symptoms of leukemia?

People with leukemia may have few or no symptoms during the early stages of the disease. Chronic leukemia develops slowly, while acute leukemia progresses more rapidly. At later stages, the uncontrolled growth of immature or abnormal blood cells can crowd out normal white blood cells that fight infections, red blood cells that carry oxygen to the body's tissues and platelets that enable blood to clot. Very high levels of leukemia cells can interfere with blood circulation. Symptoms of leukemia may include:

- Fever and night sweats
- Frequent infections
- Swollen lymph nodes
- Loss of appetite or unexplained weight loss
- Anemia (low red blood cell count)
- Fatigue or weakness
- Shortness of breath
- Easy bruising or bleeding
- Small red spots under the skin (petechiae)
- Pain or pressure below the ribs

How is leukemia diagnosed?

A blood test known as a complete blood count takes an inventory of the different types of blood

cells. Leukemia is often diagnosed after this test shows an abnormally high white blood cell count. A sample of bone marrow (a biopsy) may be withdrawn with needle to examine in a lab. Once cancer is diagnosed, various types of imaging scans, a spinal tap or other tests may be done to see how much it has spread. As leukemia progresses, the lymph nodes, liver or spleen may become enlarged. Sometimes leukemia can spread to the brain and spinal cord, the testicles or the gums.

Leukemia cells look abnormal under a microscope and may have genetic mutations. Further testing is done to see if leukemia cells are granulocytes or lymphocytes, and in the latter case, if they are B cells or T cells. Some leukemia cells have a mutation known as a Philadelphia chromosome that makes them susceptible to certain drugs. Leukemia is staged based on the percentage of immature blast cells in the bone marrow and blood and by the depletion of normal blood cells.

How is leukemia treated?

Treatment for leukemia varies according to the type, whether it is acute or chronic, the stage of the disease, a patient's age and prior treatment history. Treatment for acute leukemia may need to start immediately after diagnosis.

Cancer that did not respond to prior therapy (known as being refractory) or has relapsed is harder to treat. Treatment for acute leukemia typically involves an induction phase to put the cancer into remission, followed by a continuation phase to prevent relapse.

Watchful waiting: Treatment may not be started right away and the patient is monitored for signs and symptoms of disease progression, known as active surveillance. This may be an option for slow-progressing chronic leukemia.

Radiation: Radiation is used to reduce the number of abnormal blood cells. It may be used in conjunction with other forms of treatment.

Chemotherapy: Traditional chemotherapy works by killing fast-growing cancer cells. It can also destroy rapidly dividing healthy cells, such as those in the gut or hair follicles, leading to side effects like nausea and hair loss. In some cases, chemotherapy is directly administered into the fluid around the brain and spinal cord.

Targeted therapy: Targeted drugs work against cancers with specific characteristics. For example, they may interfere with signaling pathways that regulate cell growth. Several tyrosine kinase inhibitors are used to treat leukemia. Other types of targeted therapy help the immune system recognize and attack cancer cells.

Immunotherapy: This type of treatment helps the immune system fight cancer. For example, some tumors can turn off immune responses against them, and drugs known as checkpoint inhibitors can restore T cells' ability to recognize and destroy cancer cells.

CAR-T: The newest type of immune-based treatment, chimeric antigen receptor T cell therapy, involves removing a sample of T cells, genetically reprogramming them in a lab them to attack cancer cells, multiplying the cells and putting them back into the body. The first approved CAR-T

therapy treats B cell ALL in children.

Chemoimmunotherapy: Treatment that combines traditional chemotherapy and immunotherapy.

Spleen removal: The spleen, which removes old blood cells from circulation, may be removed if it becomes enlarged.

Stem cell transplant: Bone marrow contains stem cells that give rise to all types of blood cells. A patient's cancerous blood cells are destroyed with radiation or chemotherapy and replaced with either preserved stem cells from the same individual or bone marrow from a donor. This may be followed by an infusion of lymphocytes from the same donor. There is a risk that donor immune cells will attack the recipient's tissues, known as graft-versus-host disease.

New types of immunotherapy, including CAR-T, were originally developed for blood cancers like leukemia and lymphoma. Some patients respond very well to this kind of treatment, remaining cancer-free for years, but others do not respond as well. Many clinical trials are underway to test experimental therapies for different types of leukemia.

For more information about leukemia, visit:

American Cancer Society: Leukemia

American Cancer Society: Leukemia in Children

National Cancer Institute

Leukemia and Lymphoma Society

For more information about leukemia, please visit our sister site Cancer Health.

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