



What is Acute Myeloid Leukemia (AML)?

Acute myeloid leukemia (AML) is a cancer of cells in the blood, bone marrow and lymph nodes. AML is also called **acute nonlymphocytic leukemia, acute myeloblastic leukemia, or acute granulocytic leukemia.**

In AML, the bone marrow begins producing large numbers of abnormal blasts. Instead of producing all three types of mature blood cells, the bone marrow begins to produce only one type, usually immature white blood cell blasts called myeloblasts. These **myeloblasts** then overrun the bloodstream. They can also invade the brain, skin, ovaries and testes, and other organs. AML cells occasionally form a solid tumor called an isolated granulocytic sarcoma or chloroma.

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

There are different subtypes of AML.

The AML subtypes are based on how mature (developed) the cancer cells are at the time of diagnosis and how different they are from normal cells.

The effects of AML are:

- 1) the uncontrolled, exaggerated growth and accumulation of cells called "leukemic blasts," which fail to function as normal blood cells, and
- 2) the blockade of the production of normal marrow cells, leading to a deficiency of red cells (anemia), and platelets (thrombocytopenia) and normal white cells (especially neutrophils, i.e. neutropenia) in the blood.

Acute myelogenous leukemia is the most common type of leukemia in adults, with an estimated 10,100 new cases of AML reported each year. Older people are more likely to develop AML than children. In fact, the risk for developing the disease increases about ten-fold from age 30 (1 case per 100,000) to age 70 (1 case per 10,000).

Acute myelogenous leukemia may be called by several names, including acute myelocytic leukemia, acute myeloblastic leukemia, acute granulocytic leukemia, or acute nonlymphocytic leukemia.

AML Subtypes

The subtypes of AML are classified based on the stage of development myeloblasts have reached at the time of diagnosis. The categories and subsets allow the physician to decide what treatment works best for the cell type and how quickly the disease may develop.

(Designation / Cell subtype) -

M1, Myeloblastic, without maturation
M2, Myeloblastic, with maturation
M3, Promyelocytic
M4, Myelomonocytic
M5, Monocytic
M6, Erythroleukemia
M7, Megakaryocytic

AML is a very common form of leukemia in adults. More than 10,000 adults are diagnosed each year in the USA. 65 is the average age of people diagnosed with AML. Acute myelogenous leukemia affects more men than women, and is a little more common among whites than blacks.

Smoking, previous chemotherapy treatment, and exposure to radiation may affect the risk of developing adult AML.

Possible risk factors for AML include the following:

- Being male.
- Smoking, especially after age 60.
- Having had treatment with chemotherapy or radiation therapy in the past.
- Having had treatment for childhood acute lymphoblastic leukemia (ALL) in the past.
- Being exposed to atomic bomb radiation or the chemical benzene.
- Having a history of a blood disorder such as myelodysplastic syndrome.

Possible Signs of Adult AML

The early signs of AML may be like those caused by the flu or other common diseases. A doctor should be consulted if any of the following problems occur:

- Fever.
- Shortness of breath.
- Easy bruising or bleeding.
- Petechiae (flat, pinpoint spots under the skin caused by bleeding).

- Weakness or feeling tired.
- Loss of appetite or weight loss.

Tests Used to Detect and Diagnose Adult AML.

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 sample made up of red blood cells.
- **Blood chemistry studies:** A procedure in which a blood sample is checked to measure the amounts of certain substances released into the blood by organs and tissues in the body. An unusual (higher or lower than normal) amount of a substance can be a sign of disease in the organ or tissue that produces it.
- **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 aspiration and biopsy:** The removal of a small piece of bone and bone marrow by inserting a needle into the hipbone or breastbone. A pathologist views the bone and bone marrow 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 viewed under a microscope to look for certain changes in the chromosomes.
- **Immunophenotyping:** A process used to identify cells, based on the types of antigens or markers on the surface of the cell. This process is used to diagnose the subtype of AML by comparing the cancer cells to normal cells of the immune system.

Once adult AML has been diagnosed, tests are done to find out if the cancer has spread to other parts of the body.

The extent or spread of cancer is usually described as stages. In adult acute myeloid leukemia (AML), the subtype of AML and whether the leukemia has spread outside the blood and bone marrow are used instead of the stage 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.

There is No Standard Staging System for Adult AML.

The disease is described as

- untreated,
- in remission,
- or recurrent.

Adult AML Untreated

In untreated adult AML, the disease is newly diagnosed. It has not been treated except to relieve symptoms such as fever, bleeding, or pain and the following are true:

- The complete blood count is abnormal.
- At least 20% of the cells in the bone marrow are blasts (leukemia cells).
- There are signs or symptoms of leukemia.

Adult AML in Remission

In adult AML in remission, the disease has been treated and the following are true:

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

Adult AML Recurrent

Recurrent AML is cancer that has recurred (come back) after it has been treated. The AML may come back in the blood or bone marrow.

Factors Affecting Prognosis and Treatment Options.

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

- The age of the patient.
- The subtype of AML.
- Whether the patient received chemotherapy in the past to treat a different cancer.
- Whether there is a history of a blood disorder such as myelodysplastic syndrome.

- Whether the cancer has spread to the central nervous system.
- Whether the cancer has been treated before or 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 from a system called "Glycolosis."	Cancer cells derive almost all their 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.
Blood Vessels	
Normal Cells	Cancer Cells
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.
Growth Factors	
Normal Cells	Cancer Cells
While similar to cancer cells, the amount of them is more in balance to	These cells have over produced, require more chemicals (food) and are

produce a more normal level of activity.	over active.
Functions	
Normal Cells	Cancer Cells
The enzymes and hormones go about business in a normal balanced manner.	The enzymes and hormones are either over active or under active.
Tumors are Different	
Benign	Malignant
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.

Types of Treatment for Patients with Adult AML

Different types of treatment are available for patients with adult acute myeloid leukemia (AML). Some treatments are standard (the currently used treatment), and some are being tested in clinical trials. Before starting treatment, patients may want to think about taking part in a clinical trial. 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 AML usually has 2 phases.

The 2 treatment phases of adult AML are:

- **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 after 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.

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 (intrathecal chemotherapy), an organ, or a body cavity such as the abdomen, the drugs mainly affect cancer cells in those areas (regional chemotherapy). Intrathecal chemotherapy may be used to treat

adult AML that has spread, or may spread to the brain and spinal cord. Combination chemotherapy is treatment using more than one anticancer drug. The way the chemotherapy is given depends on the subtype of the cancer being treated and whether it has spread to the brain and spinal cord.

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. The way the radiation therapy is given depends on the type and stage of the cancer being treated.

3. Stem cell transplantation

Stem cell transplantation is a method of giving chemotherapy and replacing blood-forming cells that are abnormal or destroyed by the cancer treatment. Stem cells (immature blood cells) are removed from the blood or bone marrow of the patient or a donor and are frozen and stored. 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 Myeloid Leukemia

Standard treatment of untreated adult acute myeloid leukemia (AML) during the remission induction phase depends on the subtype of AML and may include the following:

- Combination chemotherapy.
- High-dose combination chemotherapy.
- Stem cell transplantation using donor stem cells.
- All-trans retinoic acid (ATRA) plus chemotherapy.
- Intrathecal chemotherapy.

Adult Acute Myeloid Leukemia in Remission

Standard treatment of adult AML during the remission phase depends on the subtype of AML and may include the following:

- Combination chemotherapy.
- High-dose chemotherapy, with or without radiation therapy, and stem cell transplantation using the patient's stem cells.
- High-dose chemotherapy and stem cell transplantation using donor stem cells.

Recurrent Adult Acute Myeloid Leukemia

Standard treatment of recurrent adult AML depends on the subtype of AML and may include the following:

- Combination chemotherapy.
- Biologic therapy with monoclonal antibodies.
- Stem cell transplantation.
- Low-dose radiation therapy as palliative therapy to relieve symptoms and improve quality of life.
- Arsenic trioxide therapy.

Side Effects of Cancer Treatments

Severe Anemia

The main side effects of leukemia chemotherapy treatment are severe anemia (the risk of bleeding from a low platelet count) and a high likelihood of infection. This is caused because:

(1) acute myelogenous leukemia decreases the production of normal blood cells, and

(2) the levels are further decreased by the added effects of chemotherapy.

The intensity of chemotherapy required to destroy sufficient leukemia cells to permit a remission leads to even more severe decreases in red cells, phagocytes, and platelets. To reduce the side effects of severe anemia or the reduction of red cell blood transfusions are given. A platelet transfusion is usually effective in providing sufficient amounts of these cells until the beneficial effects of treatment occur several weeks later, and blood cell counts return toward normal.

Physical Symptoms & Prevention

A rise in temperature or chills may be the only signs of infection in a patient with a very low white blood cell concentration. Persistent coughing, tenderness at a site prone to infection like the area surrounding the anus or facial sinuses, sore throat, pain on urination or frequent loose stools may be signs of an infection.

The risk of infection can be decreased by vigorous hand washing by all visitors and medical personnel and meticulous care of indwelling catheter sites. Care of the gums, a site of bacterial accumulation, also is an important area of infection prevention.

The use of blood cell growth factors that stimulate the production of phagocytes can shorten the period during which the white cell count is low. Those used most frequently are granulocyte-colony stimulating factor (G-CSF) and granulocyte-macrophage colony stimulating factor (GM-CSF).

Chemotherapy affects tissues that require a high rate of cell birth (cell division) to keep them functional. The lining of the mouth, the lining of the intestines, the skin, and the hair follicles are such tissues. This explains why mouth ulcers, diarrhea, and hair loss are common after chemotherapy. Skin rashes also may occur.

Nausea and vomiting can be distressing side effects of chemotherapy. The causes are complex. The effects are the result of actions on the intestines and on centers of the brain which, when triggered, lead to vomiting. Fortunately, drugs that counteract the nausea and vomiting can relieve these distressing side effects in most cases, if they occur.

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.