



What is Chronic Myelogenous Leukemia (CML)?

Chronic myelogenous leukemia (CML) is a cancer of the blood-producing cells in the spongy inner mass of the bone, known as marrow. CML is also called **chronic granulocytic, chronic myelocytic or chronic myeloid leukemia**.

Most people with CML have a genetic abnormality where two chromosomes (long strands of genes that dictate how the body behaves) swap their end pieces. This is called translocation, and in this case involves chromosomes number 9 and 22 and is named the "Philadelphia chromosome." The mutation causes bone marrow cells (called myeloid cells) to produce an enzyme that prompts white blood cells (cells that normally fight infection) to grow unchecked. These abnormal cells do not work well and over time; crowd out normal white blood cells, red blood cells and platelets.

CML is one of four types of leukemia. Like chronic lymphocytic leukemia (CLL), CML progresses slowly at first, and people may have it for months or years before symptoms appear. CML and CLL differ in the type of white blood cells that become cancer, and CLL patients do not have the same genetic changes to their cells. Acute leukemia's, acute myelogenous leukemia (AML) and acute lymphocytic leukemia (ALL), progress more quickly.

The American Cancer Society estimates that 4,300 new cases of chronic myelogenous leukemia will be diagnosed this year in the United States. CML usually occurs in people in their 40s and beyond, although it can occur in younger patients.

Possible Signs of Chronic Myelogenous Leukemia

These and other symptoms may be caused by CML or by other conditions. A doctor should be consulted if any of the following problems occur:

- Tiredness that does not go away.
- Lack of energy.
- Weight loss (unexplained).
- Night sweats.
- Fever.
- Pain or fullness below the ribs on the left side.

Sometimes CML does not cause any symptoms at all.

Most people with CML have a gene mutation called the Philadelphia chromosome.

Every cell in the body contains DNA (genetic material) that determines how the cell looks and acts. DNA is contained inside chromosomes. In CML, part of the DNA from one chromosome moves to another chromosome. This change is called the “Philadelphia chromosome”. It results in the bone marrow making an enzyme, called tyrosine kinase, that causes too many stem cells to develop into white blood cells (granulocytes or blasts).

The Philadelphia chromosome results from a mutation called a *translocation* (two chromosomes break, then parts from each chromosome switch places). In CML, the translocation occurs between chromosomes 9 and 22 (human DNA is packaged in 23 pairs of chromosomes) and produces a new, abnormal gene called BCR-ABL. This abnormal gene produces Bcr-Abl tyrosine kinase, an abnormal protein that causes the excess WBCs typical of CML.

The Philadelphia chromosome is an *acquired* mutation — that is, a person is not born with it and it is not passed on to their children. Exactly why the Philadelphia chromosome forms is unknown in most cases, although exposure to ionizing radiations (such as during the atomic bomb explosions in Japan) has been shown to cause CML.

The Philadelphia chromosome is not passed from parent to child.

Tests Used to Detect and Diagnose Chronic Myelogenous Leukemia.

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 an enlarged spleen. 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.
- **Cytogenetic analysis:** A test in which cells in a sample of blood or bone marrow are viewed under a microscope to look for certain changes in the chromosomes, such as the Philadelphia chromosome.
- **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 both the bone and bone marrow samples under a microscope to look for abnormal cells.

Factors Affecting Prognosis and Treatment Options.

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

- The patient's age.
- The phase of CML.
- The amount of blasts in the blood or bone marrow.
- The size of the spleen at diagnosis.
- The patient's general health.

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 "Glycolysis."	Cancer cells derive almost all their energy from "Glycolysis."
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 produce a more normal level of activity.	These cells have over produced, require more chemicals (food) and are 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.

After diagnosis: Tests to Determine if Cancer Has Spread.

Staging is the process used to find out how far the cancer has spread. There is no standard staging system for chronic myelogenous leukemia (CML). Instead, the disease is classified by phase: chronic phase, accelerated phase, or blastic phase. It is important to know the phase in order to plan treatment. The following tests and procedures may be used to find out the phase:

- **Cytogenetic analysis:** A test in which cells in a sample of blood or bone marrow are viewed under a microscope to look for certain changes in the chromosomes, such as the Philadelphia chromosome.
- **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 both the bone and bone marrow samples under a microscope to look for abnormal cells.

Chronic Myelogenous Leukemia Has 3 Phases.

As the amount of blast cells increases in the blood and bone marrow, there is less room for healthy white blood cells, red blood cells, and platelets. This may result in infections, anemia, and easy bleeding, as well as bone pain and pain or fullness below the ribs on the left side. The amount of blast cells in the blood and bone marrow and the severity of symptoms determine the phase of the disease.

1. Chronic phase

In chronic phase CML, there are 5% or fewer blast cells in the blood and bone marrow.

2. Accelerated phase

In accelerated phase CML, there are 6% to 30% blast cells in the blood and bone marrow.

3. **Blastic phase**

In blastic phase CML, there are 30% or more blast cells in the blood or bone marrow. When tiredness, fever, and an enlarged spleen occur during the blastic phase, it is called blast crisis.

There are different types of treatment for patients with chronic myelogenous leukemia.

Different types of treatment are available for patients with CML. 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.

Six types of Standard Treatment for CML:

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, an organ, or a body cavity such as the abdomen, the drugs mainly affect cancer cells in those areas (regional chemotherapy). The way the chemotherapy is given depends on the type and stage of the cancer being treated.

2. **Other drug therapy**

Imatinib (Gleevec) is a new type of cancer drug, called a tyrosine kinase inhibitor. It blocks the enzyme, tyrosine kinase, that causes stem cells to develop into more white blood cells (granulocytes or blasts) than the body needs.

3. **Biologic therapy**

Biologic therapy is a treatment that uses the patient's immune system to fight cancer. Substances made by the body or made in a laboratory are used to boost, direct, or restore the body's natural defenses against cancer. This type of cancer treatment is also called biotherapy or immunotherapy.

4. **High-dose chemotherapy with stem cell transplantation**

High-dose chemotherapy with stem cell transplantation is a method of giving high doses

of 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 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.

5. Donor lymphocyte infusion (DLI)

Donor lymphocyte infusion (DLI) is a cancer treatment that may be used after stem cell transplantation. Lymphocytes (a type of white blood cell) from the stem cell transplant donor are removed from the donor's blood and may be frozen for storage. The donor's lymphocytes are thawed if they were frozen and then given to the patient through one or more infusions. The lymphocytes see the patient's cancer cells as not belonging to the body and attack them.

6. Surgery

Splenectomy is surgery to remove the spleen.

Other Types of Treatment Available in Clinical Trials.

1. Chronic Phase Chronic Myelogenous Leukemia

Treatment of chronic phase chronic myelogenous leukemia may include the following:

- High-dose chemotherapy with donor stem cell transplantation.
- Biologic therapy (interferon) with or without chemotherapy.
- Other drug therapy (Gleevec).
- Chemotherapy.
- Splenectomy.
- A clinical trial of a new treatment.

2. Accelerated Phase Chronic Myelogenous Leukemia

Treatment of accelerated phase chronic myelogenous leukemia may include the following:

- Stem cell transplantation.
- Other drug therapy (Gleevec).
- Biologic therapy (interferon) with or without chemotherapy.
- High-dose chemotherapy.
- Chemotherapy.
- Transfusion therapy to replace red blood cells, platelets, and sometimes white blood cells, to relieve symptoms and improve quality of life.
- A clinical trial of a new treatment.

3. Blastic Phase Chronic Myelogenous Leukemia

Treatment of blastic phase chronic myelogenous leukemia may include the following:

- Other drug therapy (Gleevec).
- Chemotherapy using one or more drugs.
- High-dose chemotherapy.
- Donor stem cell transplantation.
- Chemotherapy as palliative therapy to relieve symptoms and improve quality of life.
- A clinical trial of a new treatment.

4. Relapsed Chronic Myelogenous Leukemia

Treatment of relapsed chronic myelogenous leukemia may include the following:

- Donor stem cell transplantation.
- Donor lymphocyte infusion.
- Biologic therapy (interferon).
- A clinical trial of biologic therapy, combination chemotherapy, or other drug therapy (Gleevec).

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.