Chronic Myeloid Leukemia Early Detection, Diagnosis, and Staging

Detection and Diagnosis

Catching cancer early often allows for more treatment options. Some early cancers may have signs and symptoms that can be noticed, but that is not always the case.

- Can Chronic Myeloid Leukemia Be Found Early?
- Signs and Symptoms of Chronic Myeloid Leukemia
- How Is Chronic Myeloid Leukemia Diagnosed?

Stages and Outlook (Prognosis)

After a cancer diagnosis, staging provides important information about the extent of cancer in the body and anticipated response to treatment.

- How Is Chronic Myeloid Leukemia Staged?

Questions to Ask About CML

Here are some questions you can ask your cancer care team to help you better understand your CML diagnosis and treatment options.

- What Should You Ask Your Doctor About Chronic Myeloid Leukemia?

Can Chronic Myeloid Leukemia Be Found Early?

The American Cancer Society recommends screening tests for certain cancers in
people who have no symptoms because these cancers are easier to treat if found early. But at this time, no screening tests are routinely recommended to find chronic myeloid leukemia (CML) early.

CML can sometimes be found when routine blood tests are done for other reasons. For instance, a person's white blood cell count may be very high, even though he or she doesn't have any symptoms.

It is important to report any symptoms that could be caused by CML to the doctor right away. The symptoms of CML are discussed in Signs and Symptoms of Chronic Myeloid Leukemia.

- References
See all references for Chronic Myeloid Leukemia

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**Signs and Symptoms of Chronic Myeloid Leukemia**

The symptoms of chronic myeloid leukemia (CML) are often vague and are more often caused by other things. They include:

- Weakness
- Fatigue
- Night sweats
- Weight loss
- Fever
- Bone pain
- An enlarged spleen (felt as a mass under the left side of the ribcage)
- Pain or a sense of "fullness" in the belly
- Feeling full after eating even a small amount of food

But these aren’t just symptoms of CML. They can occur with other cancers, as well as
many non-cancerous conditions.

Some patients have bone pain or joint pain caused by leukemia cells spreading from the marrow cavity to the surface of the bone or into the joint.

**Problems caused by a shortage of blood cells**

Many of the signs and symptoms of CML occur because the leukemia cells replace the bone marrow's normal blood-making cells. As a result, people with CML do not make enough red blood cells, properly functioning white blood cells, and blood platelets.

- **Anemia** is a shortage of red blood cells. It can cause weakness, tiredness, and shortness of breath.
- **Leukopenia** is a shortage of normal white blood cells. This shortage increases the risk of infections. Although patients with leukemia may have very high white blood cell counts, the leukemia cells do not protect against infection the way normal white blood cells do.
- **Neutropenia** means that the level of normal neutrophils is low. Neutrophils, a type of white blood cell, are very important in fighting infection from bacteria. People who are neutropenic have a high risk of getting very serious bacterial infections.
- **Thrombocytopenia** is a shortage of blood platelets. It can lead to excess bruising or bleeding, with frequent or severe nosebleeds and bleeding gums. Some patients with CML actually have too many platelets (*thrombocytosis*). But since those platelets often do not function properly, these people often have problems with bleeding and bruising as well.

The most common sign of CML is an abnormal white blood cell count (blood counts are discussed further in [How is Chronic Myeloid Leukemia Diagnosed?](https://www.cancer.org/cancer/chronic-myeloid-leukemia/detection/how-is-cml-diagnosed.html)).

- **References**

[See all references for Chronic Myeloid Leukemia](https://www.cancer.org/cancer/chronic-myeloid-leukemia/diagnosis-treatment.html)
How Is Chronic Myeloid Leukemia Diagnosed?

Many people with CML do not have symptoms when it is diagnosed. The leukemia is often found when their doctor orders blood tests for an unrelated health problem or during a routine checkup. Even when symptoms are present, they are often vague and non-specific.

If signs and symptoms suggest you may have leukemia, the doctor will need to check samples (specimens) of blood and bone marrow to be certain of this diagnosis. Blood is usually taken from a vein in the arm. Bone marrow is obtained through a procedure called a bone marrow aspiration and biopsy. These samples are sent to a lab, and they are looked at under a microscope for leukemia cells.

Doctors will look at the size and shape of the cells in the samples and whether they contain granules (small spots seen in some types of white blood cells). An important factor is whether the cells look mature (like normal circulating blood cells) or immature (lacking features of normal circulating blood cells). The most immature cells are called myeloblasts (often just called blasts). An important feature of a bone marrow sample is how much of it is blood-forming cells. This is known as cellularity. Normal bone marrow contains both blood-forming cells and fat cells.

When the bone marrow has more blood-forming cells than expected, it is said to be hypercellular. If too few of these cells are found, the marrow is called hypocellular.

In people with CML, the bone marrow is often hypercellular because it is full of leukemia cells. These tests may also be done after treatment to see if the leukemia is responding to treatment.

Lab tests

One or more of the following lab tests may be used to diagnose CML or to help determine how advanced the disease is.

Blood cell counts and blood cell exam

The complete blood count (CBC) is a test that measures the levels of different cells, like red blood cells, white blood cells, and platelets, in the blood. The CBC often includes a
differential (diff), which is a count of the different types of white blood cells in the blood sample. In a blood smear, some of the blood is put on a slide to see how the cells look under the microscope.

Most patients with CML have too many white blood cells with many early (immature) cells. Sometimes CML patients have low numbers of red blood cells or blood platelets. Even though these findings may suggest leukemia, this diagnosis usually needs to be confirmed by another blood test or a test of the bone marrow.

**Blood chemistry tests**

These tests measure the amount of certain chemicals in the blood, but they are not used to diagnose leukemia. They can help find liver or kidney problems caused by the spread of leukemia cells or by the side effects of certain chemotherapy drugs. These tests also help determine if treatment is needed to correct low or high blood levels of certain minerals.

**Genetic tests**

Some sort of gene testing will be done to look for the Philadelphia chromosome and/or the \textit{BCR-ABL} gene. This type of test is used to confirm the diagnosis of CML.

**Conventional cytogenetics**

This test looks at chromosomes (pieces of DNA) under a microscope to find any changes. It is also called a \textit{karyotype}. Because chromosomes can best be seen when the cell is dividing, a sample of blood or bone marrow has to be grown (in the lab) so that the cells start to divide. This takes time, and is not always successful.

Normal human cells have 23 pairs of chromosomes, each of which is a certain size. The leukemia cells in many CML patients contain an abnormal chromosome known as the \textit{Philadelphia chromosome}, which looks like a shortened version of chromosome 22. It is caused by swapping pieces (translocation) between chromosomes 9 and 22 (see \textit{Do We Know What Causes Chronic Myeloid Leukemia?}). Finding a Philadelphia chromosome is helpful in diagnosing CML. Even when the Philadelphia chromosome can't be seen, other tests can often find the \textit{BCR-ABL} gene.

**Fluorescent in situ hybridization**
Fluorescent in situ hybridization (FISH) is another way to look at chromosomes. This test uses special fluorescent dyes that only attach to specific genes or parts of chromosomes. In CML, FISH can be used to look for specific pieces of the \textit{BCR-ABL} gene on chromosomes. It can be used on regular blood or bone marrow samples without culturing the cells first, so the results can come back more quickly than with conventional cytogenetics.

**Polymerase chain reaction (PCR)**

This is a super-sensitive test that can be used to look for the \textit{BCR-ABL} oncogene in leukemia cells. It can be done on blood or bone marrow samples and can detect very small amounts of \textit{BCR-ABL}, even when doctors can't find the Philadelphia chromosome in bone marrow cells with cytogenetic testing.

PCR can be used to help diagnose CML and is also useful after treatment to see if copies of the \textit{BCR-ABL} gene are still there. If copies of this gene are still present it means that the leukemia is still present, even when the cells aren't detectable with a microscope.

**Imaging tests**

Imaging tests produce pictures of the inside of the body. They are not needed to diagnose CML, but sometimes may be done to look for the cause of symptoms or to see if the spleen or liver are enlarged.

**Computed tomography scan**

A \textit{CT scan} can help tell if any lymph nodes or organs in your body are enlarged. It isn't usually needed to diagnose CML, but it may be done if your doctor suspects the leukemia is growing in an organ, like your spleen.

In some cases, a CT can be used to guide a biopsy needle precisely into a suspected abnormality, such as an abscess. For this procedure, called a \textit{CT-guided needle biopsy}, you remain on the CT scanning table while a radiologist moves a biopsy needle through the skin and toward the location of the mass. CT scans are repeated until the needle is within the mass. A sample is then removed to be looked at under a microscope. This is rarely needed in CML.

**Magnetic resonance imaging scan**
Magnetic resonance imaging (MRI) scans are very helpful in looking at the brain and spinal cord.

**Ultrasound**

Ultrasound can be used to look at lymph nodes near the surface of the body or to look for enlarged organs inside your abdomen such as the kidneys, liver, and spleen. This is an easy test to have, and it doesn't use radiation. For most scans you simply lie on a table, and a technician moves the transducer over the part of your body being looked at.

- References
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### How Is Chronic Myeloid Leukemia Staged?

Most types of cancer are assigned a stage based on the size of the tumor and the extent of cancer spread. Stages can be helpful in predicting prognosis (outlook).

But because chronic myeloid leukemia (CML) is a disease of the bone marrow, it isn't staged like most cancers. The outlook for someone with CML depends on other information, such as the phase of the disease, as well as factors like the age of the patient, blood counts, and if the spleen is enlarged.

### Phases of chronic myeloid leukemia

CML is classified into 3 groups that help predict outlook. Doctors call these groups *phases* instead of stages. The phases are based mainly on the number of immature white blood cells — myeloblasts (blasts) — that are seen in the blood or bone marrow. Different groups of experts have suggested slightly different cutoffs to define the phases, but a common system (proposed by the World Health Organization) is
described below. Not all doctors may agree with or follow these cutoff points for the different phases. If you have questions about what phase your CML is in, be sure to have your doctor explain it to you.

**Chronic phase**

Patients in this phase typically have less than 10% blasts in their blood or bone marrow samples. These patients usually have fairly mild symptoms (if any) and usually respond to standard treatments. Most patients are diagnosed in the chronic phase.

**Accelerated phase**

Patients are considered to be in accelerated phase if any of the following are true:

- The bone marrow or blood samples have more than 10% but fewer than 20% blasts
- High blood basophil count (basophils making up at least 20% of the white blood cells)
- High white blood cell counts that do not go down with treatment
- Very high or very low platelet counts that are not caused by treatment
- New chromosome changes in the leukemia cells

Patients whose CML is in accelerated phase may have symptoms such as fever, poor appetite, and weight loss. CML in the accelerated phase does not respond as well to treatment as CML in the chronic phase.

**Blast phase (also called acute phase or blast crisis)**

Bone marrow and/or blood samples from a patient in this phase have more than 20% blasts. The blast cells often spread to tissues and organs beyond the bone marrow. These patients often have fever, poor appetite, and weight loss. In this phase, the CML acts much like an aggressive acute leukemia.

**Prognostic factors for chronic myeloid leukemia**

Along with the phase of CML, there are other factors that may help predict the outlook for survival. These factors are sometimes helpful when choosing treatment. Factors that tend to be linked with shorter survival time are called *adverse prognostic factors*.

**Adverse prognostic factors:**
Accelerated phase or blast phase
- Enlarged spleen
- Areas of bone damage from growth of leukemia
- Increased number of basophils and eosinophils (certain types of granulocytes) in blood samples
- Very high or very low platelet counts
- Age 60 years or older
- Multiple chromosome changes in the CML cells

Many of these factors are taken into account in the Sokal system, which develops a score used to help predict prognosis. This system considers the person's age, the percentage of blasts in the blood, the size of the spleen, and the number of platelets. These factors are used to divide patients into low-, intermediate-, or high-risk groups. Another system, called the Euro score, includes the above factors, as well as the number of blood basophils and eosinophils. Having more of these cells indicates a poorer outlook.

The Sokal and Euro models were helpful in the past, before the newer, more effective drugs for CML were developed. It's not clear how helpful they are at this time in predicting a person's outlook. Targeted therapy drugs like imatinib (Gleevec®) have changed the treatment of CML dramatically over the last several years. These models haven't been tested in people who are being treated with these drugs.

**Survival Rates for Chronic Myeloid Leukemia**

Highly effective drugs to treat most cases of chronic myeloid leukemia (CML) first became available in 2001. There is no accurate information yet on how long patients treated with these drugs may live. All that is known is that most patients who have been treated with these drugs, starting in 2001 (or even before), are still alive.

One large study of CML patients treated with imatinib (Gleevec®) found that about 90% of them were still alive 5 years after starting treatment. Most of these patients had normal white blood cells and chromosome studies after 5 years on the drug.

- References
See all references for Chronic Myeloid Leukemia

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What Should You Ask Your Doctor About Chronic Myeloid Leukemia?

As you cope with cancer and cancer treatment, you need to have honest, open discussions with your doctor. You should feel free to ask any question that's on your mind, no matter how small it might seem. Here are some questions you might want to ask. Nurses, social workers, and other members of the treatment team may also be able to answer many of your questions.

- What **phase** is my chronic myeloid leukemia in?
- What are my **treatment choices**?
- Which treatment do you recommend, and why?
- How long will treatment last and what will it be like?
- How often will you test my blood or bone marrow to see how my therapy is working?
- What side effects are there to the treatments that you recommend?
- What can I do to be ready for treatment?
- Should I consider a **stem cell transplant** at this time?
- What are the chances that my leukemia will come back once I am in remission?
- What type of follow-up will I need after treatment?

Be sure to write down any questions that occur to you that are not on this list. For instance, you might want information about recovery times so that you can plan your work schedule. Or you may want to ask about second opinions or qualifying for clinical trials.

Taking another person and/or a tape recorder to your appointments can be helpful. Getting copies of your medical records, including pathology and radiology reports, may be useful in case you wish to seek a second opinion at a later time.

- **References**
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