**Leukopheresis** — A special machine is used to filter the blood.

**Bone marrow transplantation** — Bone marrow transplantation is used to replace the patient’s bone marrow with healthy bone marrow. First, all of the bone marrow in the body is destroyed with high doses of chemotherapy, with or without radiation therapy. Healthy marrow is then taken from another person (a donor) whose tissue is the same as or almost the same as the patient’s. The donor may be a twin (the best match), a brother or sister, or a person who is not related. The healthy marrow from the donor is given to the patient through a needle in the vein, and the marrow replaces the marrow that was destroyed. A bone marrow transplant using marrow from a relative or person not related to the patient is called an allogeneic bone marrow transplant.

**What is the prognosis for patients with CML?**
Patients who undergo bone marrow transplantation have a very good prognosis, but not everyone is a candidate for transplant and transplant is very risky and sometimes causes fatal side effects. However, the tyrosine kinase inhibitors are very effective and the vast majority of patients who take them go into remission and remain in remission for a long time. Because of this, the prognosis is very good. Without treatment, CML is fatal.

**Can CML be prevented?**
At this time, there is no known way to prevent the disease.

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**Chronic Myeloid (or Myelogenic) Leukemia (CML)**

**What is leukemia?**
Leukemia is cancer—an abnormal, uncontrolled growth of cells—that begins in the developing cells of the bone marrow, the soft, spongy tissue inside the large bones of the body where blood cells are formed. There are more than a dozen varieties of leukemia. The two main classifications of leukemia are myelogenous (myeloid) and lymphocytic (lymphoid), and each can be acute (progressing quickly) or chronic (progressing slowly). The four most common types of leukemia are:

- Chronic myelogenous (myeloid) leukemia
- Acute myelogenous (myeloid) leukemia
- Chronic lymphocytic (lymphoid) leukemia
- Acute lymphocytic (lymphoid) leukemia

**What is chronic myeloid leukemia?**
Chronic myelogenous leukemia (CML) is a slowly progressing cancer that affects the body’s white blood cells (called lymphocytes). The bone marrow produces all types of blood cells: red blood cells that carry oxygen and other materials to the tissues of the body, white blood cells that fight infection, and platelets that help make the blood clot.

The bone marrow controls the production of normal cells. In leukemia, the process breaks down, and the bone marrow starts producing large numbers of blood cells. Although these cells are normal in appearance and function, their uncontrolled growth can lead to a more dangerous leukemia.
What are the symptoms of CML?
CML progresses slowly, and there may be no symptoms in its early stages. However, as the disease progresses, symptoms may begin to appear. Call your doctor if the following signs or symptoms appear:

- Persistent tiredness, weakness or lack of energy
- Sudden appearance of small red marks on the skin
- Bone pain
- Pressure under the left ribs (symptoms of an enlarged spleen)
- Fever
- Excessive sweating, especially at night
- Bleeding and bruising
- Loss of appetite

What causes CML?
CML is associated with a genetic abnormality called the Philadelphia chromosome. The Philadelphia chromosome carries the gene bcr/abl. Bcr/abl creates a protein that causes the leukemia.

Who gets CML?
CML usually occurs in young or middle aged adults, but it can occur in children. Some risk factors include high doses of radiation therapy used to treat other cancers or very high levels of radiation that some World War II survivors experienced.

How is CML diagnosed?
If you have symptoms, your doctor may order blood tests to count the number of each of the different kinds of blood cells. More blood tests may be done if the results of the initial blood tests are not normal. Your doctor also may do a bone marrow biopsy. During this test, a needle is inserted into a bone (usually the hip bone), and a small amount of bone marrow is taken out and examined under a microscope. A cytogenetic analysis is used to examine the chromosomes of the leukemic cells. This helps to determine if it is CML.

- FISH is a test used to measure the patient's percentage of CML cells.
- PCR is a sensitive test when the CML is not detected by other means. PCR can detect bcr/abl even if the Philadelphia chromosome cannot be identified.

Phases of CML
If the doctor diagnoses CML, more tests may be done to determine how advanced it is. CML progresses through different phases, and these phases are the stages used to plan treatment.

The following phases occur in CML:
- **Chronic phase** - There are few blast cells (less than 15 percent) in the blood and bone marrow. There may be no other symptoms. This phase may last from several months to several years.
- **Accelerated phase** - There are more blast cells (15-29 percent) in the blood and bone marrow, and fewer normal cells. Spleen may be enlarged.
- **Blastic phase or “blast crisis”** - More than 30 percent of the cells in the blood or bone marrow are blast cells. Sometimes, blast cells will form tumors outside of the bone marrow in places such as the bone or lymph nodes. (Lymph nodes are small, bean-shaped organs that make and store infection-fighting cells.) Red blood cells and platelets are decreased. Patients may experience fatigue, shortness of breath and frequent infections.

How is CML treated?
Treatment of CML depends on the phase of the disease, as well as the patient’s age and overall health. Treatment for CML may include one or more of the following:

- **Chemotherapy** — Chemotherapy uses drugs to kill cancer cells. (One example is Hydrea®). Chemotherapy may be taken by pill, or it may be put into the body by a needle in a vein or muscle. Chemotherapy is called a systemic treatment because the drug enters the bloodstream, travels through the body and can kill cancer cells throughout the body. Sometimes, chemotherapy is put into the fluid that surrounds the brain by inserting a needle in the brain or back. This is called intrathecal chemotherapy.

- **Tyrosine kinase inhibitors** — These drugs, like Gleevec®, Sprycel®, and Tasigna® directly interfere with bcr/abl and thus halt the leukemia from growing. They are taken as pills and have fewer side effects than chemotherapy.

- **Radiation therapy** — Radiation therapy uses X-rays or other high-energy rays to kill cancer cells and shrink tumors. Radiation for CML usually comes from a machine outside the body (external radiation therapy).

- **Biological therapy** — Biological therapy tries to get the body to fight cancer. It uses materials made by the patient’s body or made in a laboratory to boost, direct or restore the body’s natural defenses against disease. Biological therapy is sometimes called biological response modifier therapy or immunotherapy.

- **Surgery** — If the spleen is swollen, the doctor may remove it in a procedure called a splenectomy. This is only done in rare cases.