**Chronic Myeloid Leukemia**

Leukemia that begins in myeloid cells is called myeloid, myeloblastic or myelogenous, leukemia. Chronic Myelogenous Leukemia (CML) is a cancer of the blood cells in which too many myeloid cells are made by the bone marrow. The growth of the cells is driven by a defect (change) in the chromosomes (genes) which tell the cells what to do.

This defect is a cross of genetic material from chromosome 9 onto chromosome 22. This forms the Philadelphia (Ph) chromosome. The site of the new Ph chromosome creates a new gene called BCR-ABL. This gene makes the protein that causes myeloid cells to grow without control. CML most commonly affects adults.

There are three different phases of CML. The phases are based on the number of immature blood cells (blast cells) in your blood or bone marrow. The CML phases are called:

- **Chronic Phase CML**: This is the phase that most people have when they first receive a leukemia diagnosis. Symptoms are milder in this phase. After leukemia treatment is started, people can usually return to their usual daily activities. Less than 10% of cells in the blood or bone marrow are blast cells.

- **Accelerated Phase CML**: People in this phase may have a decreased number of red blood cells in their blood. This is called anemia. The number of blast cells is higher than in chronic phase (about 10% - 19%). These cells may grow faster than in the chronic phase. People in this phase may feel ill.

- **Blast Crisis Phase CML**: People in this phase have a high number of immature blast cells in their bone marrow and blood, similar to acute leukemia. The numbers of red blood cells, white blood cells and platelets may be low. This may cause the person to have anemia, bleeding or infections. There may also be shortness of breath or bone pain. The leukemia cells generally grow quickly as in acute leukemia. Twenty percent or more of cells in the blood or bone marrow are blast cells.

**What are the symptoms of CML?**
The abnormal leukemia cells travel throughout the body in blood vessels just like all blood cells. Sometimes they become trapped by the liver or spleen, which become swollen or enlarged. People who have CML usually notice symptoms slowly. Common symptoms include:

- Fatigue, tiring more easily
- Shortness of breath in everyday activities
- Pale skin
- Swollen spleen, an organ on the upper left side of the abdomen
- Weight loss for no clear reason
- Night sweats

Leukemia symptoms may be vague and can also be caused by other illnesses. Call your treatment team if you have any of these symptoms.

**How is CML diagnosed?**

- Full medical history by your doctor
- Full physical exam with attention paid to enlarged liver and spleen
- **Blood tests:** Complete Blood Count (CBC) to check the number of white blood cells, red blood cells and platelets in your blood. CML usually causes the red blood cells to be lower than normal. It typically causes a high or very high number of white blood cells. The number of platelets may be higher than normal. Learn more about understanding your blood counts.
- **Blood Cell Examination:** a test on the blood cells where the blood cells are stained with a colored dye and looked at through a microscope. It is also called a blood smear. CML usually has an increased number of blood cells in the blood.
- **Biopsy:** a test to remove a very small piece of tissue to look for cancer cells in your bone marrow. The tissue usually comes from the back of your hipbone. The test is done with numbing medicine to reduce the discomfort of the procedure. The removed tissue is looked at under the microscope by a pathologist (tissue doctor) to check for leukemia cells. Some of the cells are sent for genetic analysis to look for the special BCR-ABL gene. A bone marrow aspiration and biopsy are usually done together, in the doctor’s office.

  **Bone marrow aspiration:** using a hollow needle to remove the liquid sample of bone marrow into a syringe

  **Bone marrow biopsy:** capturing the solid piece of the bone marrow that stays in the bone marrow needle after it is removed from the patient. This solid piece is placed in a jar.

- **Cytogenetic Analysis:** a test on the sample of bone marrow or blood to determine the make-up of the genetic material inside of the cells. There are many changes in genes that
have been linked to CML, including the Philadelphia (Ph) chromosome. Other genetic changes may be found as well, which may indicate a different form of leukemia. These findings are important in the planning of leukemia treatment.

- **Polymerase chain reaction (PCR):** This is a sensitive test that can find the BCR-ABL gene inside CML cells. PCR can be done on cells from your blood or bone marrow.

**What is the Treatment for CML?**

There are several treatment options for people with CML depending on the phase of CML. Treatment options depend on age, general health, the phase of CML, the number of blast cells in the blood or bone marrow, and the size of the spleen.

Chronic Phase CML: the goal of treatment is to restore your blood cell numbers to normal and destroy all cells that have the BCR-ABL cancer gene.

Accelerated and Blast Crisis Phase CML: the goal is to destroy all cells that have the BCR-ABL cancer gene or return your disease to the Chronic Phase CML.

Targeted therapy is the first line of leukemia treatment. CML cells contain a gene, Bcr-abl, which causes the CML cells to grow out of control. Bcr-abl is a type of protein known as a *tyrosine kinase*. Drugs known as *tyrosine kinase inhibitors* (TKIs) that target Bcr-Abl are the standard treatment for CML. These are pills that are taken once or twice daily. Examples include drugs called imatinib, dasatinib, and nilotinib. Your doctor can review the side effects of each of these drugs with you. Each drug requires monitoring with doctor’s visits and blood tests.

**Clinical Trials**

Clinical trials are research studies of new drugs, new combinations of drugs or already approved drugs being studied to treat patients in new/different ways. They may include new drug doses or new ways (schedules) to give the drugs. Clinical trials are run under strict guidelines. Their purpose is to help find out whether new cancer treatments are safe and effective or better than the standard (current) treatment. At Massachusetts General Hospital, there are several clinical trials open for the treatment of leukemia that use the latest in cancer treatments.
If you have any questions or would like to speak with one of our physicians, please call the Center for Leukemia at Massachusetts General Hospital at 617 724 1124. You can speak to a senior Leukemia physician 24 hours a day/ 7 days a week by calling Dr. Karen Ballen at 617-724-5700 beeper 31343.