About Chronic Myeloid Leukemia

Overview of CML

If you have been diagnosed with chronic myeloid leukemia or are worried about it, you likely have a lot of questions. Learning some basics is a good place to start.

- What Is Chronic Myeloid Leukemia?

Research and Statistics

See the latest estimates for new cases of chronic myeloid leukemia and deaths in the US and what research is currently being done.

- Key Statistics for Chronic Myeloid Leukemia
- What's New in Chronic Myeloid Leukemia Research?

What Is Chronic Myeloid Leukemia?

Cancer starts when cells in the body start to grow out of control. Cells in nearly any part of the body can become cancer, and can spread to other parts of the body. To learn more about how cancers start and spread, see What Is Cancer?[1]

Chronic myeloid leukemia (CML) is also known as chronic **myelogenous** leukemia. It's a type of cancer that starts in certain blood-forming cells of the bone marrow.

In CML, a genetic change takes place in an early (immature) version of myeloid cells -- the cells that make red blood cells, platelets, and most types of white blood cells (except lymphocytes). This change forms an abnormal gene called *BCR-ABL*, which turns the cell into a CML cell. The leukemia cells grow and divide, building up in the bone marrow and spilling over into the blood. In time, the cells can also settle in other parts of the body, including the spleen. CML is a fairly slow growing leukemia, but it can change into a fast-growing acute leukemia that's hard to treat.

CML occurs mostly in adults, but very rarely it occurs in children, too. In general, their treatment is the same as for adults.

What is leukemia?

Leukemia is a cancer that starts in the blood-forming cells of the bone marrow. When one of these cells changes and becomes a leukemia cell, it no longer matures the way it should. Often, it divides to make new cells faster than normal. Leukemia cells also don't die when they should. They build up in the bone marrow and crowd out normal cells. At some point, leukemia cells leave the bone marrow and spill into the bloodstream, often causing the number of white blood cells (WBCs) in the blood to increase. Once in the blood, leukemia cells can spread to other organs, where they can keep other cells in the body from working properly.

Leukemia is different from other types of cancer that start in organs like the lungs, colon, or breast and then spread to the bone marrow. Cancers that start in another part of the body and then spread to the bone marrow are not leukemia.

Not all leukemias are the same. Knowing the specific type of leukemia helps doctors better predict each patient's prognosis (outlook) and plan the best treatment.

What is a chronic leukemia?

A leukemia is **acute** or **chronic** depending on whether most of the abnormal cells are immature (and are more like stem cells) or mature (and are more like normal white blood cells).

In chronic leukemia, the cells mature partly but not completely. These cells may look fairly normal, but they're not. They generally do not fight infection as well as normal white blood cells do. The leukemia cells also live longer than normal cells, build up, and crowd out normal cells in the bone marrow. Chronic leukemias can take a long time before they cause problems, and most people can live for many years. But chronic leukemias are generally harder to cure than acute leukemias.

What is a myeloid leukemia?

Whether leukemia is **myeloid** or **lymphocytic** depends on which bone marrow cells[2] the cancer starts in.

- Myeloid leukemias (also known as **myelocytic**, **myelogenous**, or **non-lymphocytic** leukemias) start in early myeloid cells -- the cells that become white blood cells (other than lymphocytes), red blood cells, or platelet-making cells (megakaryocytes).
- Lymphocytic (also known as **lymphoid** or **lymphoblastic** leukemias) start in cells that become lymphocytes.

What are the other types of leukemia?

There are 4 main types of leukemia, based on whether they are acute or chronic, and myeloid or lymphocytic:

- Acute myeloid (or myelogenous) leukemia (AML)[3]
- Chronic myeloid (or myelogenous) leukemia (CML)
- Acute lymphocytic (or lymphoblastic) leukemia[4] (ALL)
- Chronic lymphocytic leukemia (CLL)[5]

In **acute** leukemias, the bone marrow cells cannot mature the way they should. These immature cells continue to reproduce and build up. Without treatment, most people with acute leukemia would only live a few months. Some types of acute leukemia respond well to treatment, and many patients can be cured. Other types of acute leukemia have a less favorable outlook.

Lymphocytic leukemias start in the cells that become lymphocytes. Lymphomas are also cancers that start in those cells. The main difference between lymphocytic leukemias and lymphomas is that in leukemia, the cancer cell is mainly in the bone marrow and blood, while in lymphoma it tends to be in lymph nodes and other tissues.

Chronic myelomonocytic leukemia (CMML) is another chronic leukemia that starts in myeloid cells. For more information, see Chronic Myelomonocytic Leukemia[6].

Hyperlinks

1. www.cancer.org/cancer/cancer-basics/what-is-cancer.html
2. www.cancer.org/cancer/chronic-lymphocytic-leukemia/about/normal-tissue.html
3. www.cancer.org/cancer/acute-myeloid-leukemia.html
4. www.cancer.org/cancer/acute-lymphocytic-leukemia.html
5. www.cancer.org/cancer/chronic-lymphocytic-leukemia.html
6. www.cancer.org/cancer/chronic-myelomonocytic-leukemia.html

References

See all references for Chronic Myeloid Leukemia (www.cancer.org/cancer/chronic-myeloid-leukemia/references.html)

Last Medical Review: June 19, 2018 Last Revised: June 19, 2018

Normal Bone Marrow and Blood

Different types of leukemia are formed from different cells. To understand the different types of leukemia, it helps to know something about the blood and lymph systems.

Bone marrow

Bone marrow is the soft inner part of some bones such as the skull, shoulder blades, ribs, pelvis, and backbones. Bone marrow is made up of a small number of blood stem cells, more mature blood-forming cells, fat cells, and supporting tissues that help cells grow.

Inside the bone marrow, blood stem cells develop into new blood cells. During this process, the cells become either lymphocytes (a kind of white blood cell) or other blood-forming cells. These blood-forming cells can develop red blood cells, white blood cells (other than lymphocytes), or platelets.

Types of blood cells

Red blood cells carry oxygen from the lungs to all other tissues in the body, and take

carbon dioxide back to the lungs to be removed. Having too few red blood cells in the body (anemia[1]) can make you feel tired, weak, and short of breath because your body tissues are not getting enough oxygen.

Platelets are cell fragments made by a type of bone marrow cell called the megakaryocyte. Platelets are important in plugging up holes in blood vessels caused by cuts or bruises. Having too few platelets[2](thrombocytopenia) may cause you to bleed or bruise easily.

White blood cells help the body fight infections. Having too few white blood cells (neutropenia[3]) lowers your immune system and can make you more likely to get an infection.

Types of white blood cells

Lymphocytes are mature, infection-fighting cells that develop from lymphoblasts, a type of blood stem cell in the bone marrow. Lymphocytes are the main cells that make up lymphoid tissue, a major part of the immune system. Lymphoid tissue is found in lymph nodes , the thymus gland, the spleen, the tonsils, the adenoids, and is scattered throughout the digestive and respiratory systems and the bone marrow. The 2 major types of lymphocytes are B lymphocytes (B cells) and T lymphocytes (T cells). Lymphocytes help protect your body from germs. Some types of lymphocytes help regulate the immune system.

Granulocytes are mature, infection-fighting cells that develop from myeloblasts, a type of blood-forming cell in the bone marrow. Granulocytes have granules that show up as spots under the microscope. These granules contain enzymes and other substances that can destroy germs, such as bacteria. The 3 types of granulocytes -- neutrophils, basophils, and eosinophils -- have granules that are different in size and color when looked at with a microscope. Neutrophils are the most common type of granulocyte in the blood. They have a key role in destroying bacteria that have invaded the blood.

Monocytes develop from blood-forming monoblasts in the bone marrow and are related to granulocytes. After circulating in the bloodstream for about a day, monocytes enter body tissues to become macrophages, which can destroy some germs by surrounding and digesting them. Macrophages also help lymphocytes recognize germs and start making antibodies to fight them.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-

blood-counts/anemia.html
2. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts/bleeding.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/low-blood-counts/infections.html

References

See all references for Chronic Myeloid Leukemia (www.cancer.org/cancer/chronic-myeloid-leukemia/references.html)

Last Medical Review: June 19, 2018 Last Revised: June 19, 2018

Key Statistics for Chronic Myeloid Leukemia

The American Cancer Society's estimates for chronic myeloid leukemia (CML) in the United States for 2020 are:

- About 8,450 new cases will be diagnosed with CML (4,970 in men and 3,480 in women).
- About 1,130 people will die of CML (670 men and 460 women).

About 15% of all new cases of leukemia are chronic myeloid leukemia. About 1 person in 526 will get CML in their lifetime in the United States.

The average age at diagnosis of CML is around 64 years. Almost half of cases are diagnosed in people 65 and older. This type of leukemia mainly affects adults, and is rarely seen in children.

Visit the American Cancer Society's Cancer Statistics Center[1] for more key statistics.

Hyperlinks

1. https://cancerstatisticscenter.cancer.org/

References

American Cancer Society. *Cancer Facts & Figures 2020*. Atlanta, GA: American Cancer Society; 2020.

Cancer Stat Facts: Leukemia-Chronic Myeloid Leukemia, 2010-2014. National Cancer Institute, Bethesda, MD. https://seer.cancer.gov/statfacts/html/clyl.html. Accessed on January 5, 2018.

Jabbour E, Kantarjian H. Chronic myeloid leukemia: 2018 update on diagnosis, therapy and monitoring. *Am J Hematol*. 2018;93(3):442-459.

SEER Lifetime Risk (Percent) of Being Diagnosed with Cancer by Site and Race/Ethnicity: Both Sexes, 18 SEER Areas, 2012-2014 (Table 1.15) National Cancer Institute, Bethesda, MD. Accessed at https://seer.cancer.gov/csr/1975_2014/results_merged/topic_lifetime_risk.pdf on January 5, 2018.

See all references for Chronic Myeloid Leukemia (www.cancer.org/cancer/chronic-myeloid-leukemia/references.html)

Last Medical Review: June 19, 2018 Last Revised: January 8, 2020

What's New in Chronic Myeloid Leukemia Research?

Chronic myeloid leukemia (CML) is being studied in labs and in clinical trials around the world.

Genetics of chronic myeloid leukemia

Scientists are making great progress in understanding how changes in a person's DNA

can cause normal bone marrow cells to develop into CML cells. Learning about changes in the genes (regions of the DNA) involved in CML is providing insight into why these cells grow too quickly, live too long, and fail to develop into normal blood cells. The explosion of knowledge in recent years is being used to develop many new drugs.

Researchers are looking closely at how specific gene changes[1] could be used to determine treatment, predict disease progression, and develop other drugs to treat CML.

Treatment

Choosing the best targeted drug

Imatinib, dasatinib, nilotinib, and other tyrosine kinase inhibitor (TKI) drugs that target the BCR-ABL protein have proven to work very well, but by themselves these drugs don't help everyone. Studies are now looking at the effects of using higher doses of TKIs, and to see if combining these drugs with other treatments, such as chemotherapy or interferon might be better than either one alone.

Because TKIs have drastically changed the treatment and outcomes of CML, an exciting area of research is looking at whether TKI treatment can be stopped. Clinical trials are being done to see if this is possible and what should be done if the CML comes back. This has also led scientists to look for better ways to define molecular remission in an effort to help make decisions about stopping treatment.

New drugs for CML

Because researchers know a main cause of CML is the *BCR-ABL* gene and its protein, they've been able to develop many new drugs that might work against it. Still, these drugs don't always work, and CML can become resistant to TKIs over time. Scientists continue to look for new drugs to treat CML, especially CML that no longer responds to TKIs.

In some people, CML cells develop a change in the *BCR-ABL* oncogene known as a T315I mutation, which makes them resistant to many of the TKI drugs used today. Ponatinib is the only TKI that can work against T315I mutant cells. More drugs aimed at this mutation are now being tested.

Many other kinds of drugs are also being tested in clinical trials, such as immunotherapy drugs. These are given along with TKIs in hopes of getting a better response than is seen with TKIs alone.

Cancer vaccines

Cancer cells are different from normal cells, so it's sometimes possible to get the body's immune system to react against them. One way to do this is to use a cancer vaccine[2]-- a substance injected into the body that boosts the immune system and causes it to attack certain cells. Several vaccines are now being studied for use against CML, but more research is needed.

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/genetics/genes-and-cancer.html
2. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/immunotherapy/cancer-vaccines.html

References

See all references for Chronic Myeloid Leukemia (www.cancer.org/cancer/chronic-myeloid-leukemia/references.html)

Gong Z, Wang W, Hu S. Cytogenetic alterations in CML: not all created equal. *Oncotarget*. 2018;9(15):11885-11886.

Jabbour E, Kantarjian H. Chronic myeloid leukemia: 2018 update on diagnosis, therapy and monitoring. *Am J Hematol*. 2018;93(3):442-459.

Kavanagh S, Nee A, Lipton JH. Emerging alternatives to tyrosine kinase inhibitors for treating chronic myeloid leukemia. *Expert Opin Emerg Drugs*. 2018;23(1):51-62.

National Comprehensive Cancer Network, Clinical Practice Guidelines in Oncology (NCCN Guidelines®), Chronic Myeloid Leukemia, Version 4.2018 -- January 24, 2018. Accessed at www.nccn.org/professionals/physician_gls/pdf/cml.pdf on May 16, 2018.

Saikia T. The Cure of Chronic Myeloid Leukemia: Are We There Yet? *Curr Onc Rpts*. 2018;20(12):1-8.

Last Medical Review: June 19, 2018 Last Revised: June 19, 2018

Written by

The American Cancer Society medical and editorial content team (www.cancer.org/cancer/acs-medical-content-and-news-staff.html)

Our team is made up of doctors and oncology certified nurses with deep knowledge of cancer care as well as journalists, editors, and translators with extensive experience in medical writing.

American Cancer Society medical information is copyrighted material. For reprint requests, please see our Content Usage Policy (www.cancer.org/about-us/policies/content-usage.html).

cancer.org | 1.800.227.2345