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Zoology – II
Haematology
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Leukemia (American English) blood is a cancer of the blood or bone marrow characterized by an abnormal increase of blood cells, usually leukocytes (white blood cells). Leukemia is a broad term covering a spectrum of diseases.

[ ] Classification

Four major kinds of leukemia

Cell type	Acute	Chronic
Lymphocytic leukemia (or "lymphoblastic")	Acute lymphoblastic leukemia (ALL)	Chronic lymphocytic leukemia (CLL)
Myelogenous leukemia (also "myeloid" or "nonlymphocytic")	Acute myelogenous leukemia (AML)	Chronic myelogenous leukemia (CML)

Leukemia is clinically and pathologically subdivided into a variety of large groups. The first division is between its acute and chronic forms:

- Acute leukemia is characterized by the rapid increase of immature blood cells. This crowding makes the bone marrow unable to produce healthy blood cells. Immediate treatment is required in acute leukemia due to the rapid progression and accumulation of the malignant cells, which then spill over into the bloodstream and spread to other organs of the body. Acute forms of leukemia are the most common forms of leukemia in children.
- Chronic leukemia is distinguished by the excessive build up of relatively mature, but still abnormal, white blood cells. Typically taking months or years to progress, the cells are produced at a much higher rate than normal cells, resulting in many abnormal white blood cells in the blood. Whereas acute leukemia must be treated immediately, chronic forms are sometimes monitored for some time before treatment to ensure maximum effectiveness of therapy. Chronic leukemia mostly occurs in older people, but can theoretically occur in any age group.

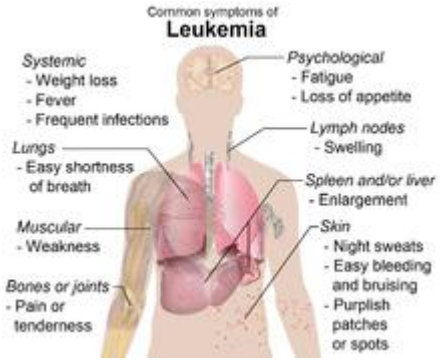
Additionally, the diseases are subdivided according to which kind of blood cell is affected. This split divides leukemias into lymphoblastic or lymphocytic leukemias and myeloid or myelogenous leukemias:

- In lymphoblastic or lymphocytic leukemias, the cancerous change takes place in a type of marrow cell that normally goes on to form lymphocytes, which are infection-fighting immune system cells. Most lymphocytic leukemias involve a specific subtype of lymphocyte, the B cell.
- In myeloid or myelogenous leukemias, the cancerous change takes place in a type of marrow cell that normally goes on to form red blood cells, some other types of white cells, and platelets.

Combining these two classifications provides a total of four main categories. Within these main categories, there are typically several subcategories. Finally, hairy cell leukemia and T-cell prolymphocytic leukemia are usually considered to be outside of this classification scheme.

- *Acute lymphoblastic leukemia* (ALL) is the most common type of leukemia in young children. This disease also affects adults, especially those age 65 and older. Standard treatments involve chemotherapy and radiation. The survival rates vary by age: 85% in children and 50% in adults.[3] Subtypes include precursor B acute lymphoblastic leukemia, precursor T acute lymphoblastic leukemia, Burkitt's leukemia, and acute biphenotypic leukemia.
- *Chronic lymphocytic leukemia* (CLL) most often affects adults over the age of 55. It sometimes occurs in younger adults, but it almost never affects children. Two-thirds of affected people are men. The five-year survival rate is 75%.[4] It is incurable, but there are many effective treatments. One subtype is B-cell prolymphocytic leukemia, a more aggressive disease.
- *Acute myelogenous leukemia* (AML) occurs more commonly in adults than in children, and more commonly in men than women. AML is treated with chemotherapy. The five-year survival rate is 40%.[5] Subtypes of AML include acute promyelocytic leukemia, acute myeloblastic leukemia, and acute megakaryoblastic leukemia.
- *Chronic myelogenous leukemia* (CML) occurs mainly in adults. A very small number of children also develop this disease. Treatment is with imatinib (Gleevec) or other drugs. The five-year survival rate is 90%.[6][7] One subtype is chronic monocytic leukemia.
- Hairy cell leukemia (HCL) is sometimes considered a subset of CLL, but does not fit neatly into this pattern. About 80% of affected people are adult men. There are no reported cases in young children. HCL is incurable, but easily treatable. Survival is 96% to 100% at ten years.[8]
- T-cell prolymphocytic leukemia (T-PLL) is a very rare and aggressive leukemia affecting adults; somewhat more men than women are diagnosed with this disease.[9] Despite its overall rarity, it is also the most common type of mature T cell leukemia;[10] nearly all other leukemias involve B cells. It is difficult to treat, and the median survival is measured in months.
- Large granular lymphocytic leukemia may involve either T-cells or NK cells; like hairy cell leukemia, which involves solely B cells, it is a rare and indolent (not aggressive) leukemia. [11]
- Adult T-cell leukemia is caused by human T-lymphotropic virus (HTLV), a virus similar to HIV. Like HIV, HTLV infects CD4+ T-cells and replicates within them; however, unlike HIV, it does not destroy them. Instead, HTLV "immortalizes" the infected T-cells, giving them the ability to proliferate abnormally.

Signs and symptoms



Common symptoms of chronic or acute leukemia[12]

Damage to the bone marrow, by way of displacing the normal bone marrow cells with higher numbers of immature white blood cells, results in a lack of blood platelets, which are important in the blood clotting process. This means people with leukemia may easily become bruised, bleed excessively, or develop pinprick bleeds (petechiae).

White blood cells, which are involved in fighting pathogens, may be suppressed or dysfunctional. This could cause the patient's immune system to be unable to fight off a simple infection or to start attacking other body cells. Because leukemia prevents the immune system from working normally, some patients experience frequent infection, ranging from infected tonsils, sores in the mouth, or diarrhea to life-threatening pneumonia or opportunistic infections.

Finally, the red blood cell deficiency leads to anemia, which may cause dyspnea and pallor.

Some patients experience other symptoms. These symptoms might include feeling sick, such as having fevers, chills, night sweats and other flu-like symptoms, or feeling fatigued. Some patients experience nausea or a feeling of fullness due to an enlarged liver and spleen; this can result in unintentional weight loss. If the leukemic cells invade the central nervous system, then neurological symptoms (notably headaches) can occur.

All symptoms associated with leukemia can be attributed to other diseases. Consequently, leukemia is always diagnosed through medical tests.

The word *leukemia*, which means 'white blood', is derived from the disease's namesake high white blood cell counts that most leukemia patients have before treatment. The high number of white blood cells are apparent when a blood sample is viewed under a microscope. Frequently, these extra white blood cells are immature or dysfunctional. The excessive number of cells can also interfere with the level of other cells, causing a harmful imbalance in the blood count.

Some leukemia patients do not have high white blood cell counts visible during a regular blood count. This less-common condition is called *aleukemia*. The bone marrow still contains cancerous white blood cells which disrupt the normal production of blood cells. However, the

leukemic cells are staying in the marrow instead of entering the bloodstream, where they would be visible in a blood test. For an aleukemic patient, the white blood cell counts in the bloodstream can be normal or low. Aleukemia can occur in any of the four major types of leukemia, and is particularly common in hairy cell leukemia. [13]

Causes

No single known cause for all of the different types of leukemia exists. The known causes, which are not generally factors within the control of the average person, account for relatively few cases.[14] The different leukemias likely have different causes.

Leukemia, like other cancers, results from somatic mutations in the DNA. Certain mutations produce leukemia by activating oncogenes or deactivating tumor suppressor genes, and thereby disrupting the regulation of cell death, differentiation or division. These mutations may occur spontaneously or as a result of exposure to radiation or carcinogenic substances, and are likely to be influenced by genetic factors.[15]

Among adults, the known causes are natural and artificial ionizing radiation, a few viruses such as Human T-lymphotropic virus, and some chemicals, notably benzene and alkylating chemotherapy agents for previous malignancies.[16][17][18] Use of tobacco is associated with a small increase in the risk of developing acute myeloid leukemia in adults.[16] Cohort and case-control studies have linked exposure to some petrochemicals and hair dyes to the development of some forms of leukemia. A few cases of maternal-fetal transmission have been reported.[16] Diet has very limited or no effect, although eating more vegetables may confer a small protective benefit.[14]

Viruses have also been linked to some forms of leukemia. Experiments on mice and other mammals have demonstrated the relevance of retroviruses in leukemia, and human retroviruses have also been identified. The first human retrovirus identified was Human T-lymphotropic virus, or HTLV-1, is known to cause adult T-cell leukemia.[19]

Some people have a genetic predisposition towards developing leukemia. This predisposition is demonstrated by family histories and twin studies.[16] The affected people may have a single gene or multiple genes in common. In some cases, families tend to develop the same kind of leukemia as other members; in other families, affected people may develop different forms of leukemia or related blood cancers.[16]

In addition to these genetic issues, people with chromosomal abnormalities or certain other genetic conditions have a greater risk of leukemia.[17] For example, people with Down syndrome have a significantly increased risk of developing forms of acute leukemia, and Fanconi anemia is a risk factor for developing acute myeloid leukemia.[16]

Whether non-ionizing radiation causes leukemia has been studied for several decades. The International Agency for Research on Cancer expert working group undertook a detailed review of all data on static and extremely low frequency electromagnetic energy, which occurs naturally and in association with the generation, transmission, and use of electrical power.[20] They

concluded that there is limited evidence that high levels of ELF magnetic (but not electric) fields might cause childhood leukemia. Exposure to significant ELF magnetic fields might result in twofold excess risk for leukemia for children exposed to these high levels of magnetic fields.[20] However, the report also says that methodological weaknesses and biases in these studies have likely caused the risk to be overstated.[20] No evidence for a relationship to leukemia or another form of malignancy in adults has been demonstrated.[20] Since exposure to such levels of ELFs is relatively uncommon, the World Health Organization concludes that ELF exposure, if later proven to be causative, would account for just 100 to 2400 cases worldwide each year, representing 0.2 to 4.95% of the total incidence for that year.[21]

[ ] Diagnosis

Diagnosis is usually based on repeated complete blood counts and a bone marrow examination following symptoms observed. A lymph node biopsy can be performed as well in order to diagnose certain types of leukemia in certain situations. Following diagnosis, blood chemistry tests can be used to determine the degree of liver and kidney damage or the effects of chemotherapy on the patient. When concerns arise about visible damage due to leukemia, doctors may use an X-ray, MRI, or ultrasound. These can potentially view leukemia's effects on such body parts as bones (X-ray), the brain (MRI), or the kidneys, spleen, and liver (ultrasound). Finally, CT scans are rarely used to check lymph nodes in the chest.

Despite the use of these methods to diagnose whether or not a patient has leukemia, many people have not been diagnosed due to the fact that many of the symptoms are vague, unspecific, and can refer to other diseases. For this reason, the American Cancer Society predicts that at least one-fifth of the people with leukemia have not yet been diagnosed. [13]

[ ] Treatment

Most forms of leukemia are treated with pharmaceutical medications, typically combined into a multi-drug chemotherapy regimen. Some are also treated with radiation therapy. In some cases, a bone marrow transplant is useful.