



Acute Lymphocytic Leukemia



**The Leukemia &
Lymphoma Society®**

Fighting Blood-Related Cancers

Introduction

This booklet provides information about acute lymphocytic leukemia for patients and their families. A glossary at the end of the booklet may help the reader understand technical terms. We hope this information is of assistance. We would welcome comments as to the clarity of the information provided and the omission of information that would have been helpful.

About 3,800 new cases of acute lymphocytic leukemia are diagnosed each year in the United States. It is the most common type of leukemia in children under the age of 15. Children are the most likely to develop the disease, but it can occur at any age. Acute lymphocytic leukemia may be called by several names, including acute lymphoid leukemia and acute lymphoblastic leukemia. Before describing the disease and its management further, a brief description of normal blood and marrow is provided for background.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is distributed as a public service by The Leukemia & Lymphoma Society, with the understanding that The Leukemia & Lymphoma Society is not engaged in rendering medical or other professional services.

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** Words in the glossary are italicized the first time that they appear in the text*

Normal Blood and Marrow

Blood is composed of plasma and cells suspended in plasma. The plasma is largely made up of water in which are dissolved many chemicals. These chemicals include proteins (e.g., albumin), hormones (e.g., thyroid hormone), minerals (e.g., iron), vitamins (e.g., folic acid), and *antibodies*, including those we develop from our immunizations (e.g., polio virus antibodies). The cells include *red cells*, *platelets*, *neutrophils*, *eosinophils*, *basophils*, *monocytes*, and *lymphocytes*.

The red cells make up half the volume of the blood. They are filled with hemoglobin, the protein that picks up oxygen in the lungs and delivers oxygen to the tissues. The platelets are small cells (one-tenth the size of red cells) that help stop bleeding if you are injured. For example, if one has a cut, the blood vessels that carry blood are torn open. Platelets stick to the torn surface of the vessel, clump together, and plug up the bleeding site. Later, a firm clot forms. The vessel wall then heals at the site of the clot and returns to its normal state.

The neutrophils and monocytes are *white blood cells*. They are *phagocytes* (or eating cells) because they can ingest bacteria or fungi and kill them. Unlike the red cells and platelets, the white cells leave the blood and crawl into the tissues where they can ingest invading bacteria or fungi and help cure an infection. Eosinophils and basophils are two additional types of white cells that participate in allergic responses.

Most lymphocytes, another type of white blood cell, are in the *lymph nodes*, the *spleen*, and lymphatic channels, but some enter the blood. (See next section “The Lymphatic System.”)

The *marrow* is a spongy tissue where blood cell development takes place. It occupies the central cavity of bone. All bones have active marrow at birth.

By the time a person reaches young adulthood, the bones of the hands, feet, arms, and legs no longer have functioning marrow. The back bone (vertebrae), hip and shoulder bones, ribs, breast bone, and skull contain marrow that is actively making blood cells in adults. Blood passes through the marrow and picks up formed blood cells for circulation.

The process of blood cell formation is called *hematopoiesis*. A small group of cells, the *stem cells*, are responsible for making all the blood cells in the marrow. The stem cells eventually develop into the specific blood cells by a process of *differentiation* (see Figure 1).

When the fully developed and functional cells are formed, they leave the marrow and enter the blood. In healthy individuals there are sufficient stem cells to keep producing new blood cells continuously. Some stem cells enter the blood and circulate. They are present in such small numbers that they cannot be counted or identified in the usual type of blood counts. Their presence in the blood is important because they can be collected by special

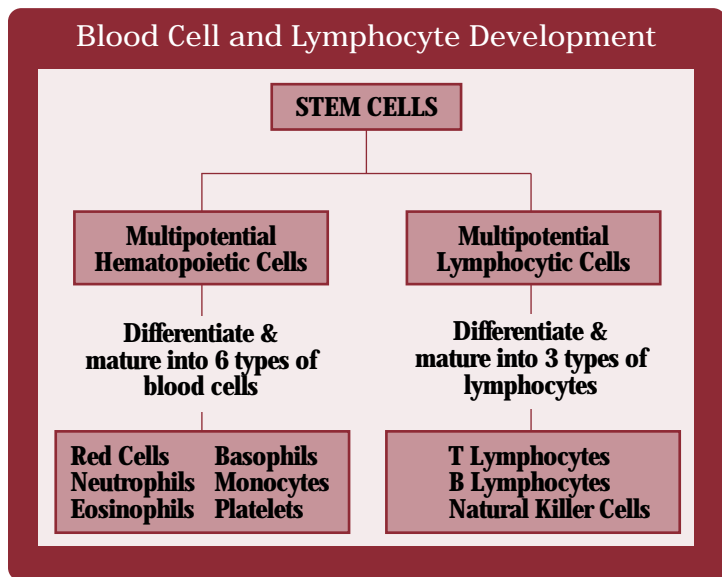


Figure 1. This figure depicts an abbreviated diagram of the process of hematopoiesis. This process involves the development of functional blood and lymphatic cells from stem cells.

techniques and transplanted into a recipient if the donor is compatible and enough stem cells are harvested. This stem cell circulation from marrow to blood and back occurs in the fetus as well. This is why, after birth, the placental and umbilical cord blood can be used as a source of stem cells for transplantation.

In summary, blood cells are made in the marrow, and when the cells are fully formed and able to function they leave the marrow and enter the blood. The red cells and the platelets perform their respective functions of delivering oxygen and plugging up injured blood vessels in the circulation. The neutrophils, eosinophils, basophils, monocytes, and lymphocytes, which are collectively the white blood cells, can crawl into tissues and can combat infection or perform other functions.

Lymphatic System

The *lymphatic system* and the blood cell-forming system in the marrow are closely related. Most lymphocytes are in the lymph nodes and other parts of the lymphatic system such as the skin, spleen, tonsils and adenoids (special lymph nodes), intestinal lining, and in young persons the thymus. The lymphocytes circulate through channels called lymphatics that connect the lymph nodes that are scattered throughout the body. The lymphatic channels collect into large ducts that empty into a blood vessel and in this way lymphocytes enter the blood. Thus, lymphocytes are present in the blood. There are three types of lymphocytes. T lymphocytes or T cells originate in the thymus, hence the designation "T." The B lymphocytes or B cells are probably derived from the bone marrow. Although the B comes from the word "bursa," an organ in birds that was first found to be the source of B lymphocytes, the B in bone marrow makes the term relevant in humans.

B lymphocytes make antibodies in response to foreign antigens, especially microbes. Collections of B lymphocytes are present in the bone

marrow, which is an important site for their function. The T lymphocytes have several functions including assisting B lymphocytes to make antibodies against invading bacteria, viruses, or other microbes. The antibodies attach to the microbe and in so doing make it possible for other white blood cells to ingest and kill them. The white cells recognize the antibody and pull (ingest) it into the cell with its attached microbe. It can then kill and digest the microbe. Natural killer or NK cells are the third type of lymphocyte. They are so named because they attack virus-infected cells as a natural function without requiring antibody or other mediation. T cells and NK cells have other functions as well and are important elements in studies that are designing immunotherapy approaches to leukemia and other cancers.

Leukemia

The earliest observations of patients who had marked elevation of their white blood cells were by European physicians in the 19th century and led to their coining the term “weisses blut” or “white blood” as a designation for the disorder. Later, the term “leukemia,” which is derived from the Greek words “leukos” meaning “white” and “haima” meaning “blood,” was used to indicate the disease. Leukemia is a special type of cancer that originates in an early cell in the blood-forming marrow or the portion of the lymphoid system that is in the marrow.

The major forms of leukemia are divided into four categories. Myelogenous and lymphocytic leukemia have an acute or chronic form. The terms myelogenous or lymphocytic denote the cell type involved. Thus, the four major types of leukemia are acute or chronic myelogenous and acute or chronic lymphocytic leukemia. The term acute lymphocytic leukemia is synonymous with acute lymphoblastic leukemia. The latter term is more frequently used to denote cases in children.

Acute leukemia is a rapidly progressing disease that affects mostly cells that are unformed or primitive (not yet fully developed or differentiated). These immature cells cannot carry out their normal functions. Chronic leukemia progresses slowly and permits the growth of greater numbers of more developed cells. In general, these more mature cells can carry out some of their normal functions. These immature cells, called “lymphoblasts” in acute lymphocytic leukemia or “myeloblasts” in acute myelogenous leukemia, multiply in an uncontrolled way and crowd out the cells that make normal blood cells. The ability to measure additional specific features of cells has led to further subclassification of the major categories of leukemia. The categories and subsets allow the physician to decide what treatment works best for the particular cell type and how quickly the disease may develop.

Acute Lymphocytic Leukemia

Acute lymphocytic leukemia (ALL) results from an acquired (not inherited) genetic injury to the DNA of a single cell in the *bone marrow*. The disease

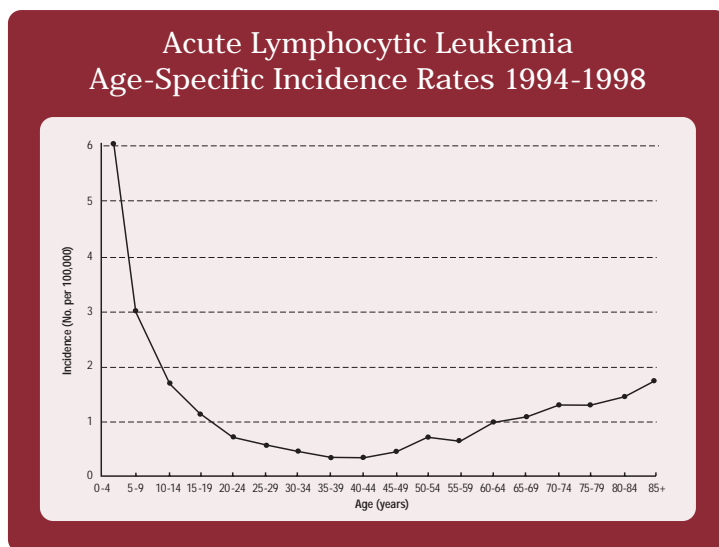


Figure 2. The horizontal axis shows 5-year age intervals. The vertical axis shows the frequency of new cases of ALL per 100,000 in a given age group. Note that the risk of ALL is greatest in the first 5 years of life. An increase in occurrence is also seen in older individuals. (Data from SEER Program of the National Cancer Institute.)

is often referred to as acute lymphoblastic leukemia because the leukemic cell that replaces the normal marrow is the (leukemic) lymphoblast. The effects are: 1) the uncontrolled and exaggerated growth and accumulation of cells called “lymphoblasts” or “leukemic *blasts*” which fail to function as normal blood cells and 2) the blockade of the production of normal marrow cells, leading to a deficiency of red cells (*anemia*), platelets (*thrombocytopenia*), and normal white cells (especially neutrophils, i.e., *neutropenia*) in the blood.

Causes and Risk Factors

In most cases, the cause of acute lymphocytic leukemia is not evident. Few factors have been associated with an increased risk of developing the disease. Exposure to high doses of irradiation, as carefully studied in the Japanese survivors of atomic bomb detonations, is one such factor.

Table 1: Subtypes of Acute Lymphocytic Leukemia

- **Immunophenotypes**

B lymphocytic lineage subtypes. These cases are identified by finding cell surface markers on the leukemic blast cells that are identical to those that develop on normal B lymphocytes. About 85 percent of cases are of the precursor B or B cell subtype.

T lymphocytic lineage subtypes. These cases are identified by finding cell surface markers on the leukemic blast cells that are identical to those that develop in normal T lymphocytes. About 15 percent of cases are of the T cell subtype.

- **Chromosome Abnormalities**

Injury to chromosomes can be assessed by cytogenetic methods, and the specific alteration in chromosomes aids in subclassifying acute lymphocytic leukemia, also. For example, a change in chromosome number 22, referred to as the Philadelphia or Ph chromosome, which occurs in a small percentage of children and a larger percentage of adults with acute lymphocytic leukemia, places the patient in a higher risk category. Thus, the approach to therapy would be intensified in those subsets of patients.

Unlike other forms of leukemia, acute lymphocytic leukemia occurs at different rates in different locations. There are higher leukemia rates in more developed countries and in higher socioeconomic groups.

The current causes of acute lymphocytic leukemia in children or adults are not known. Scientists continue to explore possible relationships with life-style or environmental factors but no firm conclusions have yet been reached. Given the amount of study, this suggests that multifaceted complex factors may be involved. It is extremely disconcerting to patients and their families to wonder what they may have done differently to avoid the disease. Unfortunately, at the present time the answer is nothing. Acute lymphocytic leukemia occurs most often in the first decade of life but increases in frequency again in older individuals (see Figure 2 on page 6).

Subtypes of Acute Lymphocytic Leukemia

Acute lymphocytic leukemia can develop from primitive lymphocytes that are in various stage of development (see Table 1 on page 7). The principal subtypes are uncovered by special tests on the leukemic lymphoblasts called *immunophenotyping*. Phenotype is the physical characteristics of the cells and these are measured using immune tools. The principal subtypes are T lymphocyte and B lymphocyte types, so named because the cell has features that are similar to normal T or B lymphocytes. In addition, the B cell type can be divided into a precursor B cell type as well. Once these features are determined the term used may be acute T lymphoblastic leukemia or acute precursor (or pre) B cell lymphoblastic leukemia. Other markers on the lymphoblasts that can be detected with immunophenotyping and may be useful to the physician include the common acute lymphoblastic leukemia antigen, cALLa, now designated CD10.

Examination of leukemic cells by *cytogenetic* techniques permits identification of chromosomes or gene abnormalities in the cells.

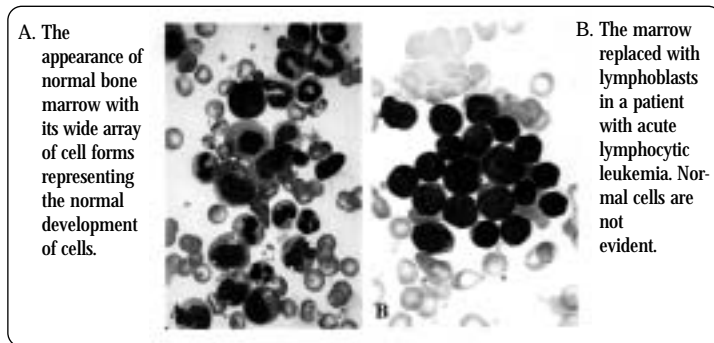


Figure 3. Panel A shows a photograph of developing cells in healthy marrow which have been placed on a glass slide and stained with dyes to make the cells more distinctive. The variation in the appearance of the cells is characteristic of normal marrow. Panel B show a photograph of marrow cells from a patient with acute lymphocytic leukemia. A monotonous appearance of leukemic blast cells is present.

The immunophenotype and chromosome abnormalities in the leukemic cells are very important guides in determining the approach to treatment and the intensity of the drug combinations to be used.

Other features are important in guiding therapy including age of the patient, level of the white blood cell count, or involvement of the central nervous system or of lymph nodes, among others.

Symptoms and Signs

Most patients feel a loss of well-being. They tire more easily and may feel short of breath when physically active. They may have a pale complexion from anemia. Signs of bleeding because of a very low platelet count may be noticed. These include black-and-blue marks occurring for no reason or because of a minor injury, the appearance of pinhead-sized, red spots under the skin called *petechiae*, or prolonged bleeding from minor cuts. Discomfort in the bones and joints may occur. Fever in the absence of an obvious cause is common. Leukemic lymphoblasts may accumulate in the lymphatic system, and lymph nodes can be enlarged. The leukemic cells can collect on the lining of the brain and spinal cord and lead to headache or vomiting.

Table 2. Drugs Used in the Treatment of Acute Lymphocytic Leukemia

Most antileukemic drugs interact with the genetic material in the cell, the DNA or deoxyribonucleic acid.

Antitumor Antibiotics

These drugs interact directly with the DNA in the nucleus of cells interfering with cell survival.

- daunorubicin (daunomycin, rubidomycin, Cerubidine)
- doxorubicin (Adriamycin, Rubex)
- mitoxantrone (Novantrone)
- idarubicin (Idamycin)

DNA Repair Enzyme Inhibitors

These drugs act on certain proteins (enzymes) that help to repair injury to DNA. These drugs prevent the enzymes from working and make the DNA more susceptible to injury.

- etoposide (VP-16, VePesid)
- teniposide (VM-26, Vumon)
- topotecan (Hycamtin)

DNA Synthesis Inhibitors

This drug reacts with DNA to alter it chemically and prevent cell growth.

- carboplatin (Paraplatin)

DNA Damaging Agents

Agents that are related to mustard gas have been developed to interact with and disrupt and damage DNA.

- cyclophosphamide (Cytosan)
- ifosfamide (Ifex)

Antimetabolites

These are chemicals that are very similar to natural building blocks of DNA or RNA. They are changed from the natural chemical sufficiently so that when they substitute for

it, they block the cell's ability to form RNA or DNA preventing the cell from growing.

- 5-azacytidine (Mylosar)
- cytarabine (cytosine arabinoside, Ara-C, Cytosar)
- 2-chlorodeoxyadenosine (Cladribine)
- fludarabine (Fludara)
- hydroxyurea (Hydrea)
- 6-mercaptopurine (Purithenol)
- methotrexate (Mexate)
- 6-thioguanine (Thioguanine)

Drugs That Prevent Cells From Dividing

These drugs interfere with structures in the cell that are needed to permit cells to divide. This effect can limit the growth rate of leukemia cells.

- vincristine (Oncovin)
- vindesine (Eldisine)

Enzymes That Prevent Cells From Surviving

- L-asparaginase (Elspar)
- PEG-L asparaginase (pegaspargase, Oncaspar)

Synthetic Hormones

A class of hormones which when administered in large doses can kill leukemia cells.

- prednisone
- prednisolone
- dexamethasone

Diagnosis

To diagnose the disease, the blood and marrow cells must be examined. In addition to low red cell and platelet counts, examination of the stained (dyed) blood cells with a light microscope will usually show the presence of leukemic blast cells. This is confirmed by examination of the marrow which almost always shows leukemia cells (see Figure 3 on page 9). The blood and/or marrow cells are also used for studies of the number and shape of chromosomes (cytogenetic examination), immunophenotyping, and other special studies, if required.

Treatment

Chemotherapy is the use of drugs to treat leukemia. Nearly all patients with acute lymphocytic leukemia require such treatment as soon after diagnosis as possible. The principal goal of treatment is to bring about a *remission* in which there is no evidence of leukemic blast cells in the blood or marrow. Normal blood cell production is restored and blood cell counts return to normal levels.

In most patients, intensive chemotherapy is required to achieve complete remission. Several drugs are combined to treat patients initially. Table 2 lists the drug groups and individual drugs that may be used to treat this disease. Approaches to treatment are undergoing intensive study throughout the world, and there are variations on the general descriptions given here. Thus, a patient may receive either a different number of drugs, sequence of drugs, or types of drugs than described here and be receiving appropriate and effective treatment. The age of the patient, the presence of few or many leukemia cells in the blood, and the type of leukemic lymphocytes as judged by their appearance, immunophenotype, or chromosome composition can influence the type of treatment given. It is, however, important to seek treatment in a center where physicians are experienced in the care of patients with acute leukemia.

In order to prepare the patient for treatment, an *indwelling catheter* is placed in a vein in the upper chest to allow ready access for infusion of drugs, blood cells, and the removal of blood samples for cell counts and chemical tests.

In some patients, if the white cell count is very high, a drug called allopurinol is given to minimize the build-up of uric acid in the blood. Uric acid, a breakdown product of cells, enters the blood and is excreted in the urine. If many cells are killed simultaneously by therapy, the amount of uric acid in the urine can be so high that uric acid kidney stones can form, which may seriously interfere with the flow of urine.

Chemotherapy

Induction Therapy

This is the initial phase of specific treatment. The specific drugs used, the doses used, and the timing of their administration depend on several factors, including the patient's age, the features of the leukemia, and the general health of the patient. Several drugs are combined. Table 3 gives examples of the drugs used today for induction and post-induction treatment. Acute lymphocytic leukemia cells often collect in the lining of the spinal cord and brain, called the meninges. If not treated, the meninges can harbor leukemia cells, and relapse can occur in this site (meningeal leukemia). For this reason, treatment is also directed to those sites by injecting drugs, like methotrexate, into the spinal column, or irradiating the covering of the central nervous system using an X-ray treatment machine. Sometimes both forms of treatment are used. Such treatment is called *central nervous system prophylaxis*. These areas of the body, which are less accessible to chemotherapy when given by mouth or in the vein, have been referred to as *sanctuary sites*.

When chemotherapy is effective, developing blood cells as well as leukemia cells are eliminated from the marrow, resulting in a severe deficiency of red cells (anemia), phagocytes (neutropenia and monocytopenia), and platelets (thrombocytopenia) in the blood. Transfusion of red cells and, often, platelets may be required. The deficiency of phagocytes (microbe-eating cells) permits bacteria and fungi, normally present on skin, in the nose, mouth, or large bowel (colon), or transferred from other persons or the environment, to establish infection during this period. Antibiotic therapy is frequently required.

In most patients after several weeks, normal blood cell production will return and transfusion of cells and antibiotics will no longer be needed. Blood cell counts gradually approach normal, well-being returns, and leukemia cells cannot be identified in blood or marrow. This is a remission. In this state, residual leukemia cells are inactive. They do not interfere with normal blood cell development but have the potential to regrow and cause

Table 3. Example of Drugs Used in the Treatment of Acute Lymphocytic Leukemia in Children

Induction therapy given in first month

- Doxorubicin by vein
- Asparaginase by injection into muscle
- Vincristine by vein
- Prednisone by mouth
- Methotrexate in the spinal canal and by vein
- Cytarabine in the spinal canal

Post-induction therapy given in cycles for two years

- Vincristine by vein
- Prednisone by mouth
- 6-mercaptopurine by mouth
- Methotrexate by mouth, vein, or into muscle
- Methotrexate in the spinal canal
- Cytarabine in the spinal canal
- Hydrocortisone into spinal canal
- Radiation to the head

Doses and timing may be varied by age of patient and features of the leukemia.

a *relapse* of the leukemia. For this reason, additional therapy in the form of chemotherapy usually continues.

Post-Remission Therapy

Since residual leukemia cells that cannot be detected by the blood or marrow examination remain after a remission, the optimal treatment of ALL requires additional intensive therapy after remission has been achieved. As in the induction phase, individual factors such as age of the patient, the ability to tolerate intensive treatment, cytogenetic findings, the availability of a stem cell donor, and others may influence the approach used. In most cases, post-remission chemotherapy also includes drugs not used during induction treatment (see Table 3).

Patients between the ages of approximately 1 and 50 years who are in remission and have an HLA-matched donor are candidates for allogeneic *stem cell transplantation*. The decision to do a transplant depends on the features of the leukemia, the age of the patient, and the patient's (or his or her family's) understanding of the potential benefits and risks. The high rate of cure of children with acute lymphocytic leukemia treated with chemotherapy decreases the frequency that stem cell transplantation is considered. A child with features that indicate a good prognosis would not be a candidate for transplantation unless his or her course was marked by a poor response to treatment or a relapse.

Childhood versus Adult Leukemia

Acute lymphocytic leukemia has an unusual pattern of age distribution (see Figure 2 on page 6). In the other types of leukemia, older people are more likely to develop the disease. In acute lymphocytic leukemia, young children are most likely to develop the disease. Risk of developing the disease peaks at 4 years of age and then decreases until about age 50. At age 50, the incidence increases again, especially among men. Although remission rates and remission duration have improved in

adults, current therapy has not resulted in the high rate of extended remissions (greater than five years) and cures possible for children.

Side Effects of Treatment and Their Management

Acute lymphocytic leukemia decreases the production of normal blood cells, but the levels are further decreased by the added effects of chemotherapy. The intensity of chemotherapy required to destroy sufficient leukemia cells to permit a remission leads to even more severe decreases in red cells, phagocytes (neutrophils and monocytes), and platelets. Severe anemia, the risk of bleeding from a low platelet count, and a high likelihood of infection may result.

Red cell and *platelet transfusions* are usually effective in providing sufficient amounts of those cells until the beneficial effects of treatment occur several weeks later and blood cell counts return toward normal. Methods of harvesting white blood cells from normal donors have improved sufficiently that blood phagocytes (neutrophils and monocytes) can be obtained in quantities sufficient to transfuse children and smaller adults, if the severity of the infection and an inadequate response to antibiotics warrants such treatment.

A rise in temperature or chills may be the only signs of infection in a patient with a very low white blood cell concentration. In this setting, persistent coughing, tenderness at a site prone to infection, sore throat, pain on urination, or frequent loose stools also may be signs of an infection. Efforts to decrease the risk of infection by vigorous hand washing by all visitors and medical personnel and meticulous care of indwelling catheter sites are important. Care of the gums, a site of bacterial accumulation, also is an important area of infection prevention. The use of blood cell *growth factors*, which stimulate the production of phagocytes, can shorten the

period during which the white cell count is low. Those used most frequently are *granulocyte-colony stimulating factor (G-CSF)* and *granulocyte-macrophage colony stimulating factor (GM-CSF)*. These agents are not usually used in children, except in special circumstances.

Chemotherapy affects tissues that require a high rate of cell birth (cell division) to keep them functioning. The lining of the mouth, the lining of the intestines, the skin, and the hair follicles are such tissues. This explains why mouth ulcers, diarrhea, and hair loss are common after chemotherapy. Skin rashes also may occur.

Nausea and vomiting can be a distressing feature of chemotherapy. The causes can be complex. The effects are the result of actions on the intestines and on centers in the brain which, when triggered, lead to vomiting. Fortunately, drugs that counteract the nausea and vomiting can be given to prevent or relieve these distressing side effects if they occur.

Refractory Leukemia and Relapsed Leukemia

Since most children are cured of their disease, this problem has become less frequent. However, some children and many adults, even after intensive treatment, have residual leukemia cells in their marrow. This circumstance is referred to as “refractory leukemia.” Some patients who have had a remission of leukemia after therapy have a return of leukemia cells in the marrow and a decrease in normal blood cells. This situation is referred to as “relapse.” In the case of refractory leukemia, different approaches, such as drugs not used in the first course of treatment or stem cell transplantation, may be used in an effort to induce remission. In patients who relapse, the duration of the remission, their age, and the cytogenetic findings in the leukemia cells influence the approach to therapy. Drugs similar to those initially used to treat the leukemia, different drugs, or stem cell transplantation may be used. In studies all over the world, scientists

are working to develop approaches to increase the number of patients who have a remission and to increase the duration of remission and the frequency of cures.

Social and Emotional Aspects

The diagnosis of leukemia may provoke a profound emotional response in the patient, family members, and friends. Denial, depression, a feeling of hopelessness, and fear are normal and usual reactions. No one response is either expected or unexpected.

A lack of understanding of what is in store, the unknown, and what is next should be met by thoughtful, straightforward, and frequent discussions among physician, nurse, patient, and family. An inability to work, tend to business affairs, or interact with family and friends in the usual manner may contribute to emotional distress. Thorough explanations, including the prospects for remission and the plans for treatment, may bring emotional relief as the patient focuses on the treatment ahead and the prospect of recovery and remission.

Children may feel frightened and helpless and may be too young to fully understand the nature of the problem. They have to reconcile lost schooling, separation from friends, and their inability to participate in everyday activities, such as sports, at least for a time. Children may direct their anger and fear of being hurt toward medical staff. Reengagement in as many activities as possible is one of the best ways to soothe and reassure the child and minimize disruptions in the child's development. Most school age children can keep up with their class work with the assistance of parents or tutors.

Parents of children with acute leukemia may be confused, angry, and fearful. Time commitments and financial burdens of the illness may cause disagreements within the family. Siblings of the patient may also be affected. They may fear the disease will strike them. They may feel

guilty that something they did or said caused their brother or sister's illness. Or they may receive less time from parents who must devote extra time to their ill child.

Family members or loved ones may have questions about chemotherapy and alternative methods of treatment. It is best to speak directly with physicians regarding specific medical questions. Family members or loved ones should discuss any problems or reactions they may have. Nurses and other health professionals also understand the complexity of emotions and the special ongoing needs of those living with leukemia. They also will spend much time with patients becoming their confidants and can be very helpful in their emotional support. For more information about the social and emotional aspects of the disease, you may request copies of the Society's publications *Coping With Survival* and *Emotional Aspects of Childhood Leukemia*.

There are programs to help ease the emotional and economic strain created by leukemia. To order publications or obtain information from The Leukemia & Lymphoma Society, call your local chapter or call the information resource center at (800) 955-4572. You may also want to visit our web site at www.leukemia-lymphoma.org to view publications and obtain more information about The Leukemia & Lymphoma Society programs and services.

Follow-Up

Patients who are in remission continue to be examined regularly by their physicians. After the induction of remission and the completion of post-remission therapy, careful periodic assessment of the patient's state of health, blood cell counts and, if necessary, marrow is required. As time progresses, the interval between assessments may be lengthened but should be continued indefinitely.

Five-Year Survival Rates Childhood Acute Lymphocytic Leukemia (ALL) Ages 0-19

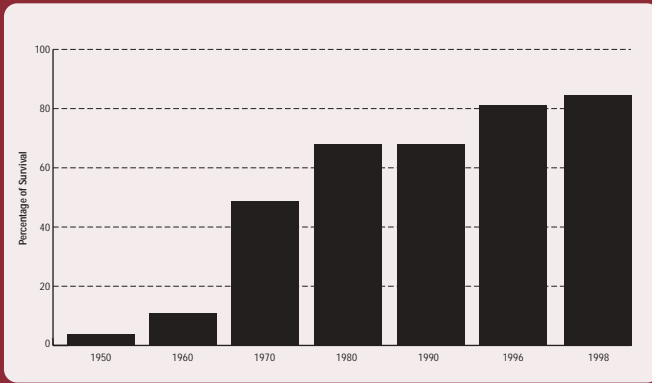


Figure 4. Horizontal axis shows year. Vertical axis shows five-year relative survival rates (percent) for children 0-19 years of age. The graph shows childhood ALL 5-year relative survival rates have improved significantly over the past 30 years. (Data from SEER program of the National Cancer Institute.)

Although current therapy of acute lymphocytic leukemia can be curative for most children, there may be long-term consequences of therapy, including effects on growth, psychosocial development, and others. Because of these possible effects, long-term follow-up and appropriate continued use of medical counseling are important.

The Future

The number of patients with acute lymphocytic leukemia who enter remission, stay in remission for years, or are cured has increased significantly over the past 30 years (see Figure 4). Several areas of research have contributed to this progress.

In children, the probability of an extended remission or cure has increased from less than 5 percent in 1950 to over 82 percent in the late 1990s.

In adults, the probability of remission has increased dramatically in the last 10 years, and extended remissions are also more frequent. Several areas of research are likely to lead to further progress.

Drug Resistance

The leukemia cells of some patients are not as easily killed by drugs as those of other patients. This may lead to a failure of current treatment. Research has uncovered mechanisms in the leukemia cell that protect it from the effects of chemotherapy. As these mechanisms are defined, ways of getting around them are also being developed.

Oncogenes

Defining the precise changes (*mutations*) in DNA that cause a normal cell to be transformed into a leukemia cell should permit new therapies to be developed. These therapies could block the effects of cancer-causing genes (*oncogenes*) and the cancer-causing proteins that the genes direct to be made.

Transplantation

The use of stem cells from blood and from cord blood may make transplantation easier. These stem cells can be frozen and stored in a manner similar to a blood bank, making them available to potential recipients who do not have related (sibling) donors with similar tissue types.

New Drug Treatments

Extensive testing is being conducted to synthesize new drugs or find them from natural (botanical) sources. These drugs are first tested for their usefulness in the laboratory and then, through the method of clinical trials, on patients. Researchers are also investigating new combinations of existing drugs for their usefulness in the treatment of leukemia, lymphoma, Hodgkin's disease, and myeloma.

Immunotherapy

Research is being conducted on several approaches that may enhance the body's natural defenses. The goal is to kill or prevent the growth of

leukemia cells. Radioimmunotherapy is an example of immunotherapy. This approach combines antibodies with attached isotopes that emit irradiation. These antibodies can be made in the laboratory. They are injected into the patient to destroy leukemia cells. Another approach uses normal lymphocytes which can attack leukemia cells because they have been immunized to recognize the leukemia cells as foreign or abnormal.

Cytokines

These naturally occurring chemicals can be made commercially using the techniques of biotechnology. These chemicals can be used to help restore normal blood cells during treatment or enhance the immune system to attack the leukemia.

Leukemia-Specific Therapy

Increasingly, clinical studies are identifying leukemia by more specific criteria than the appearance of the leukemia cells. These additional factors include the type of chromosome abnormality, the presence of *multidrug resistance* characteristics, the immunophenotype, and others. New and different drug regimens are being tested in situations that are likely to be refractory to the usual chemotherapy.

Minimal Residual Disease

Sensitive molecular techniques permit the identification of small amounts of residual leukemia cells at times when blood and marrow appear normal. This approach can be used if the leukemia cell has a detectable molecular abnormality. This approach can permit more sensitive follow-up of patients in remission and can help determine whether additional treatment is necessary.

These and other new approaches, many of which are being supported by the research programs of The Leukemia & Lymphoma Society, hold the promise of increasing the rate of remission and finding cures for all blood-related cancers.

Glossary

Anemia

A decrease in the red blood cells and, therefore, the hemoglobin concentration of the blood. This results in a decreased ability of the blood to carry oxygen. If severe, anemia can cause a pale complexion, weakness, fatigue, and shortness of breath on exertion.

Antibodies

Proteins that are made by B lymphocytes in response to foreign substances called antigens. For example, infectious agents like viruses or bacteria cause lymphocytes to make antibodies against them. In some cases (for example, the measles virus), the antibodies are protective and prevent a second infection. Antibodies can be used to identify specific cells and improve the classification of leukemia or lymphoma (see Immunophenotyping).

Apheresis

The process of removing components of a donor's blood and returning the unneeded parts to the donor. The process uses continuous circulation of blood from a donor through an apparatus and back to the donor. This process makes it possible to remove desired elements from large volumes of blood. Platelets, red blood cells, white blood cells, or plasma can be removed separately. For example, this technique permits the harvest of enough platelets for transfusion from one donor (rather than six to eight separate donors). In so doing, the recipient of the platelets is exposed to fewer donors or can be given *HLA*-matched platelets from a single related donor. This technique is also used to remove circulating blood stem cells, which can be frozen, stored, and later used, instead of marrow stem cells, for transplantation.

Autologous Stem Cell Infusion

This technique, often referred to as transplantation, involves harvesting the patient's stem cells from blood or marrow. The stem cells are often frozen for later use. The patient is then given intensive therapy, and the stem cells are reinfused via an indwelling catheter.

The blood or marrow may be obtained from a patient with a disease of the marrow (for example, acute myelogenous leukemia) when in remission or when the marrow and blood are not overtly abnormal (for example, lymphoma requiring intensive therapy). Technically, this procedure is not transplantation, which implies taking tissue from one individual (donor) and giving it to another person (recipient). The purpose of the procedure is to restore blood cell production from the preserved and reinfused stem cells after intensive therapy has severely damaged the patient's remaining marrow. This procedure was usually performed using marrow but increasingly autologous blood stem cells are used.

Basophil

A type of white blood cell that participates in certain allergic reactions.

Blast Cells

This term refers to the earliest marrow cells identified by the light microscope. Blasts represent about 1 percent of normally developing marrow cells. They are largely myeloblasts, which are cells that will develop into neutrophils. In normal lymph nodes, blasts are usually lymphoblasts, that is, cells that are part of lymphocyte development. In the acute leukemias, blast cells, similar in appearance to normal blast cells, accumulate in large numbers, perhaps up to 80 percent of all marrow cells. In acute myelogenous leukemia, myeloblasts accumulate and in acute lymphocytic leukemia, lymphoblasts accumulate. The distinction sometimes can be made by examination of stained marrow cells through the microscope. Often, immunophenotyping or use of special staining of marrow cells is required to be sure of the distinction.

Banding of Chromosomes

The staining of chromosomes with dyes that bring out or highlight bands or regions on the chromosome. The bands give the chromosomes more distinctive features, allowing better distinctions to be made among them.

Bone Marrow

The bones are hollow, and their central cavity is occupied by marrow, a spongy tissue which plays a major role in the development of blood cells. After puberty, the marrow in the spine, ribs, breast bone, hip, shoulders, and skull is most active in blood cell formation.

Bone Marrow Transplantation (see Stem Cell Transplantation)

Central Nervous System (CNS) Prophylaxis

In certain types of leukemia, particularly acute lymphocytic leukemia and acute monocytic leukemia with high blood cell counts, there is a propensity of the leukemia cells to enter the covering of the spinal cord and brain (the meninges). This process is often not apparent until months or years after remission when the leukemia returns, first in the coverings of the central nervous system, then in the marrow and blood. To prevent this type of relapse (meningeal leukemia), virtually all children and all adults with acute lymphocytic leukemia who enter remission are treated by placing appropriate chemotherapy in the space that bathes the spinal cord and brain to prevent the leukemia from returning in these sites. In some cases, X-ray therapy is administered to the head as well. These approaches are very effective in eliminating leukemia cells in the coverings of the brain and spinal cord.

Chemotherapy

The use of chemicals (drugs or medications) to kill malignant cells. Numerous chemicals have been developed for this purpose, and most act to injure the DNA of the cells. When the DNA is injured, the cells cannot

grow or survive. Successful chemotherapy depends on the fact that malignant cells are somewhat more sensitive to the chemicals than normal cells. Because the cells of the marrow, the intestinal tract, the skin, and hair follicles are most sensitive to these chemicals, injury to these organs cause the common side effects of chemotherapy, i.e., mouth sores, and hair loss.

Chromosome

All normal human cells with a nucleus contain 46 structures called chromosomes. The genes, specific stretches of DNA, are the principal structures that make up the chromosomes. An “average” sized chromosome contains enough DNA to account for about 2,000 genes. The X and Y chromosomes are the determinants of our gender and are referred to as the sex chromosomes: two X-chromosomes in females and an X- and a Y-chromosome in males. The number or shape of chromosomes may be altered in lymphoma or leukemia cells.

Clonal (monoclonal)

A population of cells derived from a single primitive cell. Virtually all neoplasms (cancers), benign and malignant, are derived from a single cell with an injury to DNA (mutated) and, thus, are clonal. The mutated cell has an alteration in its DNA which forms an oncogene and leads to its transformation into a cancer-causing cell. The cancer is the total accumulation of cells that grow from the single mutated cell. Leukemia, lymphoma, and myeloma are examples of cancers which are clonal, that is, derived from a single abnormal cell.

Colony Stimulating Factor (CSF) (see Cytokines)

Computed Tomography (CT) Scan

This is a technique for imaging body tissues and organs. X-ray transmissions are converted to detailed images using a computer to synthesize X-ray data. The images are displayed as a cross-section of the body at any

level from the head to the feet. A CT scan of the chest or abdomen permits detection of an enlarged lymph node, liver, or spleen. A CT scan can be used to measure the size of these and other structures during and after treatment.

Cultures

If an infection is suspected, it is helpful to know the principal site involved and the type of bacterium, fungus, or other microorganism involved so that the most specific antibiotics can be selected for treatment. To determine the site and organism, samples of body fluids such as sputum, blood, and urine as well as swabs of the inside of the nose, throat, and rectum are placed on culture medium in special sterile containers and incubated at body temperature (37° C, 98.6° F) for one to several days. These cultures are examined to determine if bacteria, fungi, or sometimes other organisms are present in significant numbers. If they are present, the organisms can be tested with several antibiotics to determine which antibiotic kills the organism. This process determines the “antibiotic sensitivity” of the organism.

Cycle

The term designates an intensive, clustered period of chemotherapy (and/or radiotherapy). The treatment may be given for several days or weeks and represents one cycle of treatment. The treatment plan may call for two, three, or more cycles of treatment.

Cytogenetics

This is the process of analyzing the number and shape of the chromosomes of cells. The individual who prepares, examines, and interprets the number and shape of chromosomes in cells is called a cytogeneticist.

Cytokines

These are cell (cyto-) derived chemicals that are secreted by various types of cells and act on other cells to stimulate or inhibit their function. Chemicals derived from lymphocytes are called “lymphokines.” Chemicals derived

from lymphocytes that act on other white blood cells are called “interleukins,” that is, they interact between two types of leukocytes. Some cytokines can be made commercially and used in the treatment of leukemia. Granulocyte-colony stimulating factor (G-CSF) is one such cytokine. It stimulates the production of neutrophils and shortens the period of low neutrophil counts in the blood after chemotherapy. Cytokines that stimulate cell growth are sometimes referred to as “growth factors.”

Differentiation

The process by which stem cells transform from immature cells without a specific direction into cells of a single blood cell line. The red blood cells, platelets, neutrophils, monocytes, eosinophils, basophils, and lymphocytes are formed by the process of differentiation.

Eosinophils

White blood cells that participate in allergic reactions and help to fight certain parasitic infections.

Erythrocytes

A synonym for red cells (see Red Cells).

G-CSF (see Cytokines)

GM-CSF (see Cytokines)

Granulocytes

A type of white blood cell that has a large number of granules in the cell body. Other blood cells have fewer granules (e.g., lymphocytes). Neutrophils, eosinophils, and basophils are types of granulocytes.

Growth Factors (see Cytokines)

HLA

The acronym for human leukocyte antigens. These proteins are on the surface of most tissue cells and give an individual his or her unique tissue type. The testing for HLA antigens is referred to as “tissue typing.” There are four major groups of HLA antigens: A, B, C, and D. These proteins on the surface of cells act as antigens when donated (transplanted) to another individual, the bone marrow, or stem cell recipient. If the antigens on the donor cells are identical (e.g., identical twins) or very similar (e.g., HLA-matched sibling), the transplantation (donated marrow or cells) is more likely to survive in the recipient (engraft). In addition, the recipient’s body cells are less likely to be attacked by the donated cells (graft-versus-host disease).

Hematologist

A physician who specializes in the treatment of blood cell diseases. This person is either an internist who treats adults or a pediatrician who treats children. Hematopathologists are pathologists who specialize in the diagnosis of blood cell diseases and who perform the specialized laboratory tests often required to make a conclusive diagnosis.

Hematopoiesis

This term describes the process of blood cell development in the marrow. The most undeveloped cells in the marrow are stem cells. They start the process of blood cell development. The stem cells begin to develop into young or immature blood cells like red cells or white cells of various types. This process is called “differentiation.” The young or immature blood cells then further develop into fully functional blood cells. This process is called “maturation.” The cells then leave the marrow and enter the blood and circulate throughout the body. Hematopoiesis is a continuous process that is active normally throughout life. The reason for this activity is because most blood cells live for short periods and must be continuously replaced. Red cells die in four months, platelets in 10 days, and most neutrophils

in two or three days. About five hundred billion blood cells are made each day. This requirement for very rapid replacement explains the severe deficiency in blood cell counts when the marrow is injured by replacement with leukemia, lymphoma, or myeloma cells.

Iliac Crest

The edge of the hip bone from which marrow is usually sampled for diagnosis of blood cell diseases.

Immunophenotyping

A method that uses the reaction of antibodies with antigens to determine a specific type of cell in a sample of blood cells, marrow cells, or lymph node cells. A tag is attached to antibodies that react with specific antigens in the cell. The tag can be identified by the laboratory equipment used for the test. As cells carrying their array of antigens are tagged with specific antibodies, they can be identified; for example, myelogenous leukemia cells can be distinguished from lymphocytic leukemia cells. This method helps to subclassify cell types which may, in turn, help to decide on the best treatment to apply in that type of leukemia or lymphoma.

Indwelling Catheter

Several types of catheters (e.g., Hickman, Broviac, and others) are available for patients receiving intensive chemotherapy and/or nutritional support. An indwelling catheter is a special tubing inserted into a large vein in the upper chest. The catheter is tunneled under the skin of the chest to keep it firmly in place. The external end of the catheter can be used to administer medications, fluids, or blood products or to withdraw blood samples. With meticulous care, catheters can remain in place for long periods of time (many months), if necessary.

Interleukin (see Cytokines)

Karyotype

The systematic arrangement, using photographs, of the 46 human chromosomes of a cell in 23 matched pairs (maternal and paternal member of each pair) by length from longest to shortest and other features. The sex chromosomes are shown as a separate pair (either XX or XY).

Leukocytes

A synonym for white blood cells (see White Blood Cells).

Leukopenia

A decrease below normal in the concentration of blood leukocytes (white blood cells).

Lymph Nodes

Small structures, the size of beans, that contain large numbers of lymphocytes and are connected with each other by small channels called lymphatics. These nodes are distributed throughout the body. In patients with lymphoma, Hodgkin's disease, and some types of lymphocytic leukemia, the malignant lymphocytes grow and expand the lymph nodes so that they may be enlarged in size. This enlargement of lymph nodes can be seen, felt, or measured by computed tomography (CT) scan or magnetic resonance (MR) imaging, depending on the degree of enlargement and location.

Lymphatic System

This system is made up of lymph nodes. The lymph nodes are an important site where lymphocytes are produced and beneficial immune reactions take place.

Lymphocytes

A type of white blood cell that participates in the body's immune system. There are three major types of lymphocytes: B lymphocytes that produce antibodies to help combat infectious agents like bacteria, viruses, and fungi;

T lymphocytes that have several functions, including assisting B lymphocytes to make antibodies; and natural killer cells that can attack virus-infected cells or tumor cells.

Lymphokines (see Cytokines)

Magnetic Resonance (MR) Imaging

This technique provides detailed images of body structures. It differs from a CT scan in that the patient is not exposed to X-rays. The signals generated in the tissues in response to the magnetic field are converted by computer into images of body structures such as lymph nodes. Thus, the size and any changes in size of tumor masses or organs such as the liver and spleen can be measured.

Marrow (see Bone Marrow)

Mitosis

The process by which a single cell divides into two cells. This process is also referred to as cell division, cell replication, or cell growth.

Monocytes (macrophages)

A type of white blood cell that assists in fighting infection. The monocyte, along with the neutrophil, are the two major microbe-eating and killing cells in the blood. When monocytes leave the blood and enter the tissue, they are converted to macrophages. The macrophage is the monocyte in action and can combat infection in the tissues or can serve other functions, such as ingesting dead cells (scavenger).

Multidrug Resistance

A characteristic of cells that makes them resistant to the effects of several different classes of drugs. There are several forms of multidrug resistance. They each are determined by genes that govern how the cell will respond to the drugs. The first identified mechanism of multidrug resistance (or

MDR) involves the cell's ability to eject several drugs out of cells. The cell wall rapidly ejects chemicals out of the cell preventing them from reaching a toxic concentration. In cells, the resistance to drugs can be traced to the expression of genes that direct the formation of high amounts of the protein that prevents the drugs from having their effects on the malignant cells.

Mutation

An alteration in a gene that results from a change (injury) to the DNA in a cell. A "germ cell mutation" is present in the egg or the sperm and is transmitted from parent(s) to offspring. A "somatic cell mutation" occurs in a specific tissue and can result in the growth of the specific tissue cell into a tumor. In leukemia, lymphoma, or myeloma, a primitive marrow or lymph node cell undergoes a mutation(s), which leads to the formation of a tumor. In these cases, the tumors are usually widely distributed when detected; they involve the marrow or lymph nodes, usually, in many sites.

Neutropenia

A decrease below normal in the concentration of neutrophils, a type of white blood cell.

Neutrophils

The principal phagocyte (microbe-eating) cell in the blood. This blood cell is the main cell that combats infections. It is not often present in sufficient quantities in patients with acute leukemia or after chemotherapy, which increases their susceptibility to infection. A neutrophil may be called a poly or seg.

Oncologist

A physician who diagnoses and treats patients with cancer. They are usually internists who treat adults or pediatricians who treat children. Radiation oncologists specialize in the use of radiation to treat cancer and surgical oncologists specialize in the use of surgical procedures to treat

cancer. These physicians cooperate and collaborate to provide the best treatment plan (surgery, radiation therapy, or chemotherapy) for the patient.

Oncogene

A mutated gene that is the cause of a cancer. Several subtypes of acute myelogenous leukemia, acute lymphocytic leukemia, lymphoma, and nearly all cases of chronic myelogenous leukemia have a consistent mutated gene (oncogene).

Pancytopenia

A decrease below normal in the concentration of the three major blood cell types: red cells, white cells, and platelets.

Petechiae

Pinhead-sized sites of bleeding in the skin. This type of bleeding results from a low platelet count. The small punctate hemorrhages are frequently seen on the legs, feet, trunk, and arms. They disappear gradually when the platelet count increases.

Phagocytes

Cells that readily eat (ingest) microorganisms like bacteria or fungi and can kill them as a means of protecting the body against infection. The two principal phagocytes in the blood are neutrophils and monocytes. A decrease in these blood cells is the principal cause of susceptibility to infection in patients with leukemia or those treated with intensive radiotherapy and/or chemotherapy which suppresses blood cell production in the bone marrow.

Platelets

Small blood cells (about one-tenth the volume of red cells) that stick to the site of blood vessel injury, aggregate with each other, and seal off the injured blood vessel to stop bleeding.

Platelet Transfusion

The transfusion of donor platelets is frequently needed to support patients treated for acute leukemia. The platelets can be pooled from several unrelated donors and given as “pooled random-donor platelets.” It requires the platelets from about six one-unit blood donors to significantly raise the platelet count in a recipient. Sufficient platelets can be obtained from one donor by *apheresis*. The latter technique skims the platelets of large volumes of blood passing through the apheresis machine. The red cells and plasma are returned to the donor. The advantage of single-donor platelets is that the patient is not exposed to the different antigens on platelets from many different people and is less likely to develop antibodies against donor platelets. HLA-matched platelet transfusion can be given from a related donor with an identical or very similar HLA tissue type. The platelets are collected by apheresis.

Polymerase Chain Reaction (PCR)

A technique to expand trace amounts of DNA or RNA so that the specific type of the DNA or RNA can be determined. This technique has become useful in detecting a very low concentration of residual leukemic cells, too few to be seen using a microscope. The technique can detect the presence of one leukemic cell among five hundred thousand to one million non-leukemic cells. PCR requires a specific DNA (or RNA) abnormality or marker, like an oncogene, in the leukemic or lymphomatous cells for its use.

Red Cells

Blood cells that carry hemoglobin, which binds oxygen and carries it to the tissues of the body. The red cells make up about 45 percent of the volume of the blood in healthy individuals.

Relapse

A return of the disease after it has been in remission following treatment.

Remission

A complete disappearance of a disease, usually as a result of treatment. The terms “complete” or “partial” are used to modify the term “remission.” Complete remission means all evidence of the disease is gone. Partial remission means the disease is markedly improved by treatment, but residual evidence of the disease is present.

Resistance to Treatment

The ability of cells to live and divide despite their exposure to a chemical that ordinarily kills cells or inhibits their growth. This is the cause of refractory leukemia, whereby a proportion of leukemia cells resist the damaging effects of a drug or drugs. Cells have several ways to develop drug resistance (see Multidrug Resistance).

Sanctuary Sites

These are areas in which it is difficult to get a sufficient concentration of chemotherapy to destroy leukemia cells. In acute lymphocytic leukemia, the brain and spinal cord (central nervous system) and the testes in boys are sanctuary sites of cancer.

Somatic Mutation

This event is the alteration of a gene in the cells of a specific tissue causing the gene to become a cancer-causing gene or oncogene. It is called “somatic” to distinguish it from a germ cell mutation, which can be passed from parent to offspring. Most cases of leukemia are caused by a somatic mutation in a primitive marrow (blood-forming) cell. If the mutation results from a major abnormality of chromosomes such as a translocation, it can be detected by cytogenetic examination. Often the alteration in the gene is more subtle and requires more sensitive tests to identify the oncogene.

Spleen

An organ of the body in the left upper portion of the abdomen just under the left side of the diaphragm. It contains clusters of lymphocytes like

lymph nodes do and also filters the blood of old or worn out blood cells. It is often affected in leukemia, especially the lymphocytic leukemias, lymphoma, and Hodgkin's disease. Enlargement of the spleen is referred to as "splenomegaly." Removal of the spleen by surgery is referred to as "splenectomy." Removal of the spleen can be done since its function can be performed by other organs such as the lymph nodes and liver.

Stem Cells

These are primitive cells in marrow that are important in making red blood cells, white blood cells, and platelets (see Hematopoiesis). Generally, the stem cells are largely found in the marrow but some leave the marrow and circulate in the blood. Using special techniques, the stem cells in blood can be collected, preserved by freezing and, later, thawed and used for therapy.

Stem Cell Transplantation

This is a technique developed to restore the marrow of patients who had lethal injury to that site. Such injury can occur because of primary marrow failure, destruction of marrow by disease, or intensive chemical or radiation exposure. As first designed, the source of the transplant was the marrow of a healthy donor who had the same tissue type (HLA type) as the patient. Usually, the source was a brother or sister. Donor programs have been established to identify unrelated donors who have a matching tissue type. This approach requires screening tens of thousands of unrelated individuals of similar ethnicity.

The transplant product is, specifically, a very small fraction of the marrow cells called "stem cells." These stem cells not only reside in the marrow but circulate in the blood. They can be harvested from the blood of a donor by treating the donor with an agent or agents that cause the release of larger numbers of stem cells into the blood and collecting them by apheresis. The stem cells circulate in large numbers in fetal blood also and can

be recovered from the placental and umbilical cord blood after childbirth. The harvesting, freezing, and storing of “cord blood” has provided another source of stem cells for transplantation. Since blood as well as marrow is a very good source of cells for transplantation, the term “stem cell transplantation” has replaced “bone marrow transplantation” as the general term for these procedures.

If the donor is an identical twin, the transplant is called “syngeneic,” the medical term for genetically identical. If the donor is a non-identical sibling, the transplant is called “allogeneic,” indicating it is from the same species and in practice nearly always matching in tissue type. The term “matched unrelated” is applied to the donors recruited from large-volume screening programs searching for the rare individual who is very similar in tissue type to the patient.

Unfortunately, the important technique of harvesting patients’ marrow, freezing it, and returning it to them after they have received intensive chemotherapy and/or radiotherapy for their underlying disease has been referred to as autologous (self) or auto-transplantation. This term is a well-entrenched misnomer since transplantation implies transferring tissue from one individual to another. This technique would better be referred to as autologous marrow infusion (see Autologous Stem Cell Infusion).

Therapy

The treatment of acute leukemia has different segments. Induction therapy refers to the methods used to destroy visible leukemia cells in blood and marrow to cause or “induce” a remission, which results in return of normal blood cells. Consolidation therapy is additional treatment given after remission is induced. Often, high doses of drugs are used in several short periods of treatment. The goal is to further decrease the concentration of residual leukemia cells. The greater the reduction in leukemia cells, the higher the probability that natural defenses will suppress the disease and

result in a long-term remission. Maintenance or continuation therapy refers to the administration of drugs periodically for a long period of time (months or years) usually in lower doses than consolidation therapy.

Thrombocytopenia

A decrease below normal in the concentration of the blood platelets.

Translocation

An abnormality of chromosomes in marrow or lymph node cells, which occurs when a piece of one chromosome breaks off and sticks to the end of another chromosome. In a balanced translocation, each of two chromosomes breaks off and the lost piece sticks to the broken end of the other chromosome. The gene at which the break occurs is altered. This is one form of a somatic mutation, which may transform the gene into an oncogene or cancer-causing gene.

Tumor Suppressor Gene (antioncogene)

A gene which acts to prevent cell growth. If a mutation occurs in this gene, it may make the individual more susceptible to the development of cancer in the tissue in which the mutation occurred.

White Blood Cells

A synonym for leukocytes. There are five major types of white blood cells: neutrophils, eosinophils, basophils, monocytes, and lymphocytes.

Further Readings

Society Patient Booklets

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Chapters and Free Information

Information about leukemia, lymphoma, and myeloma is available from The Leukemia & Lymphoma Society's offices located in the states and cities listed below. Please refer to your telephone directory for local address and telephone number, or call 800-955-4572.

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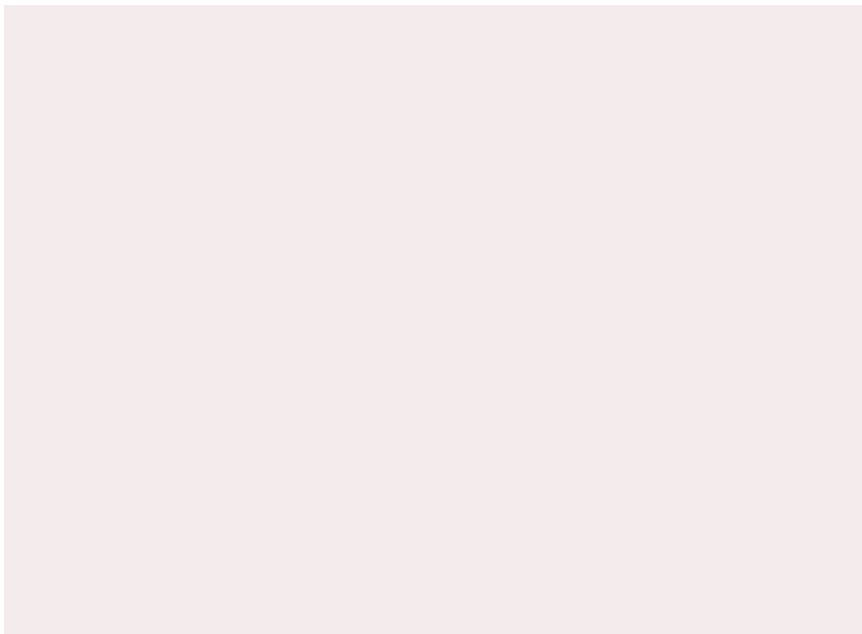
*Home Office The Leukemia & Lymphoma Society
1311 Mamaroneck Avenue – Suite 310
White Plains, NY 10605*

*Free Literature: (800) 955-4572
www.leukemia-lymphoma.org*

Mission

The mission of The Leukemia & Lymphoma Society is to cure leukemia, lymphoma, Hodgkin's disease and myeloma, and improve the quality of life of patients and their families.

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