

Leukemia

A disease of the body's own defenses

White blood cells are the body's foot soldiers in its everyday battle against infections and diseases. Even when we are feeling well, they are working together in a carefully orchestrated manner to target and destroy dangerous substances in our body. Any disease that prevents the white blood cells from doing their job puts us at great risk for infection and illness.

Leukemia is that kind of disease. It happens when our body's system for making white blood cells malfunctions, resulting in the uncontrolled production of abnormal white blood cells that cannot protect us against disease. If left untreated, leukemia can cause death in a matter of months.

Fortunately, advances in medical science have led to a better understanding of leukemia and to improved treatment. People with leukemia are now able to live healthier, happier lives.

Pronunciation

loo-KEE-mee-yuh

Synonyms & Abbreviations

- Acute lymphocytic leukemia (ALL)
- Acute myeloid leukemia (AML)
- Chronic lymphocytic leukemia (CLL)
- Chronic myeloid leukemia (CML)
- Acute nonlymphoblastic leukemia (ANLL)
- Acute monocytoid leukemia
- Monoblastic leukemia
- Acute monoblastic leukemia
- Acute granulocytic leukemia
- Acute myelocytic leukemia
- Leukemic reticuloendotheliosis

Detailed Description

To understand leukemia, it is helpful to know the normal composition of blood. Here are the kinds of blood cells normally produced within the bone marrow:

- White blood cells: There are several types of white blood cells, each of which has a unique and necessary function in the overall effectiveness of the immune system. Their role in defending the body against foreign organisms is critical.

- Red blood cells: These are the oxygen-carrying blood cells. Leukemia inhibits their growth, usually causing anemia (a shortage of red blood cells). Anemia results in weakness, pallor, and fatigue.
- Platelets: These make up the blood-clotting portion of the blood. Their decreased numbers in leukemia sufferers can result in easy bruising, nose bleeding, and other more harmful bleeding disorders.

Simply put, leukemia is a cancer of the blood cells. It usually involves the white blood cells, but in rare cases involves the red blood cells and platelets as well. The disease originates in the bone marrow. Like all cancers, it is characterized by the uncontrolled growth of abnormal cells. When these defective cells accumulate in the bone marrow where they are produced, it inhibits the production of blood cells of every kind.

All blood cells pass through many stages on their way to complete maturity, beginning within the bone marrow as immature cells called blasts. Leukemia can occur at any of these stages of development, affecting one of the two major categories of white blood cells: lymphoid cells or myeloid cells. Lymphoid leukemia and myeloid leukemia have different treatments as well as different symptoms.

Besides being categorized by the type of cell it affects, leukemia is further classified by the course and duration of the disease. Leukemia is said to be either acute or chronic. Acute leukemia has a sudden onset and involves immature cells that cannot perform their regular function. These immature cells multiply quickly, causing the disease to rapidly worsen. The symptoms of acute leukemia are more severe. People who have acute leukemia usually learn they have the disease after they go to the doctor for their symptoms.

Chronic leukemia progresses more slowly. Typically it involves more mature cells that can partially carry out their function. It is often discovered at a routine visit to the doctor's office before symptoms even arise.

About sixteen specific types of leukemia have been identified. The four broad types of leukemia are based on the categories discussed above. They are as follows:

- Acute lymphocytic leukemia (ALL): This is the most common type of leukemia in children, but it also affects older adults.
- Acute myeloid leukemia (AML): This occurs in both adults and children. This type of leukemia is sometimes called acute nonlymphocytic leukemia (ANLL).
- Chronic lymphocytic leukemia (CLL): This leukemia most often affects adults over the age of 55. Sometimes it affects young adults, but seldom affects children. It is the most common type.

- Chronic myeloid leukemia (CML): This affects mostly adults. A small number of children also develop this disease.

People with leukemia are especially susceptible to infection since their white blood cells aren't functioning properly. Secondary infections are the most common cause of death in all types of leukemia.

Characteristics of Leukemia

Leukemia's primary feature is "marrow failure." This term describes the failure of the bone marrow to produce enough healthy red blood cells, white blood cells, and platelets to carry on regular bodily functions. Basically, the abnormal cells crowd out the normal cells so good cells can't be made in enough quantity. Generally, marrow failure is characterized by increasing vulnerability to infection and illness, fatigue, fever, bone pain, and bleeding/bruising.

How Common Is Leukemia?

Each year, nearly 27,000 adults and more than 2,000 children in the United States learn that they have leukemia. It affects 13.2 per 100,000 men and 7.7 per 100,000 women in the United States. Chronic leukemia comprises 35% to 50% of all cases of leukemia. Seventy percent of leukemia occurs in adults (mostly chronic lymphocytic and acute myeloid leukemias). Thirty percent occurs in children (predominantly acute lymphocytic leukemia).

What You Can Expect

The prognosis for remission and long-term survival of leukemia depends on the age of the patient and the type of leukemia. In general, the outlook for children is somewhat better than for adults. Also, acute leukemia has a much better chance of being cured than chronic leukemia.

It is estimated that by the year 2010 one out of 1,000 young adults in the United States will be a childhood acute lymphocytic leukemia (ALL) survivor. In general, the ALL remission rate is very good for children; about 70% survive for at least five years after diagnosis. In adults, the long-term survival rate is about 20% to 30%.

For acute myeloid leukemia (AML), the disease subsides in 60% to 80% of patients. The long-term survival rate for this disease is 20% to 40%.

Chronic myeloid leukemia (CML) almost always turns into the acute form of the disease within five years. Afterward, the survival rate is poor. The average survival rate is between three and four years. Approximately 60% of adults who undergo a successful bone marrow transplant appear to be cured.

As medical science improves, the outlook for leukemia patients is improving enormously. Each

leukemia is different, just as individual responses to treatment are different. It is best to confer with your doctor regarding the chances of recovery. He or she is in the best position to make such a determination. But even then, it is important to recognize that your doctor cannot know exactly what course a disease might take.

Causes

Established Causes

Several different entities are suspected of causing leukemia, some of which have been more closely linked to the disease than others. The three major categories of possible and established causes are as follows:

- Genetic factors: A chromosomal abnormality between chromosome 9 and chromosome 22 (called the Philadelphia chromosome) has been linked to leukemia. Acute and chronic leukemias often show abnormalities of many chromosomes.
- Diseases: Myelofibrosis, polycythemia vera, and myelodysplastic diseases have been shown to predispose their sufferers to leukemia. Multiple myeloma and Hodgkin's disease also cause increased risk of developing leukemia, though the risk may be related to the treatments associated with these diseases (radiation therapy, chemotherapy).
- Physical and chemical agents: Some of these are perhaps among the most established causes of leukemia and include long-term exposure to the chemical benzene. Some risk is associated with chemotherapeutic agents such as chloramphenicol and alkylating agents. Viruses have been shown to cause leukemia in lower vertebrates and in cultured human cells, and are suspected of causing leukemias in humans. At least one rare type of leukemia (adult T-cell leukemia) has been positively linked to a specific virus.

Theoretical Causes

The theoretical causes of leukemia are mentioned above.

Risk Factors

The following factors have been linked to the development of leukemia:

- Genetic and chromosomal abnormalities: Down's syndrome sufferers are prone to the development of leukemia. Siblings of a leukemia patient are also at high risk for developing the disease. A defect in a part of the genes called the Philadelphia chromosome predisposes a person to develop chronic myeloid leukemia (CML).

- Radiation exposure: Long-term exposure to high-energy radiation increases the risk of developing leukemia.
- Immunodeficiency states
- Chemical and drug exposure (for example, benzene is a known leukemic agent)
- Cigarette smoking

Risk factors are traits or behaviors that may make you statistically more likely than others in the general population to have a certain condition. They are not necessarily "causes" of the condition. Some risk factors associated with increased occurrence of leukemia include:

- Down's syndrome
- Klinefelter's syndrome
- Bloom's syndrome
- Neurofibromatosis
- Ataxia telangiectasia
- Fanconi's anemia

Symptoms & Diagnosis

Symptoms

Depending on whether you have chronic or acute leukemia, symptoms may range from nonexistent to severe. In acute cases, symptoms tend to appear and worsen fast, and the person feels ill enough to see a doctor. In chronic cases, there may be no symptoms for a long time. When they do appear, they worsen slowly. Sometimes, chronic leukemia without symptoms is found during routine exams and blood tests.

See your doctor right right away if you have several of these warning signs, which can be found in both forms of the disease:

- **Fever, chills, and flu-like symptoms:** caused by the decrease in white blood cells, which makes a person more prone to infections. Upper respiratory infections and flu-like illnesses are common.
- **Weakness and fatigue:** due to low number of red blood cells (anemia).
- **Frequent infections:** due to decreased white blood cell count.
- **Loss of appetite/weight:** this may be related to taste alteration, or chemotherapy or radiation treatment itself.
- **Swollen/tender lymph nodes, liver, or spleen:** due to accumulation of abnormal white blood cells within these organs. Leukemia also can affect the digestive tract, kidneys, lungs, or other parts of the body.
- **Easy bleeding or bruising:** due to decreased platelet count or due to disseminated intravascular coagulation (DIC).

- **Tiny red spots (called petechiae) under the skin:** also due to decreased platelet count and predisposition of small areas to bleed.
- **Swollen gums, or gums that bleed easily.**
- **Bone or joint pain:** due to accumulation of abnormal white blood cells within bone marrow.
- **Sweating, especially at night.**
- **Testicular swelling/pain:** caused by accumulation of abnormal white blood cells.
- **Nervous system disturbances:** in the acute leukemias, abnormal white blood cells can collect in the brain and surrounding tissues as well as the spinal cord, which can cause severe headaches, nausea and vomiting, confusion, and seizures.

Conditions That May Be Mistaken for Leukemia

Leukemia may be confused with other conditions that have similar symptoms. They include:

- Virally induced cytopenia
- Immune cytopenia
- Drug-induced cytopenia
- Other marrow failure and infiltrative diseases: aplastic, hypoblastic, and refractory anemias; paroxysmal nocturnal hemoglobinuria; Gaucher's disease
- Severe Vitamin B-12 deficiency

How Leukemia Is Diagnosed

If your doctor suspects leukemia, he or she will do several tests to confirm or rule out the disease:

Physical exam

Your doctor will ask about your medical history, as well as check your overall health. He or she will also feel for swelling in the liver, spleen, and lymph nodes under the arms and in the neck and groin.

Blood testing

- **Complete blood cell count (CBC):** A sample of your blood will be tested to count the number of various types of cells. People with leukemia usually have a low number of red blood cells and platelets, while the white blood cell count may be low, normal, or high. The appearance of the cells also will be checked under a microscope. An important sign to check for are immature white blood cells called blasts. If they're found under the microscope, they point strongly to leukemia because blasts aren't normally seen in the blood.
- **Bone marrow aspiration/bone marrow biopsy:** A bone marrow aspiration or biopsy is the only way to make a firm diagnosis and to determine the type of leukemia you have. Your doctor will withdraw a sample of bone marrow from a large bone (usually the hip). With aspiration, a needle draws liquid bone marrow from the center of the bone. A biopsy is

similar to aspiration, except that the doctor uses a larger needle to remove a small plug of bone and bone marrow.

An oncologist (cancer specialist), hematologist (blood disease specialist), or pathologist (a specialist in how disease affects the body) will then examine the bone marrow under a microscope. Also, pathology tests are done on the bone marrow to look for any abnormality in number, size, shape, or maturity of cells. Special stains are used to determine if cells are myeloid or lymphoid. Usually a very sensitive test called flow cytometry is done. This classifies cells more specifically. The marrow is also checked for chromosomal abnormalities.

Staging Leukemia

With some forms of leukemia, you'll need more tests after diagnosis to uncover the extent of the disease. These "staging" tests are crucial in helping your doctor to plan the best treatment for you and to assess your chances of recovery. Among the staging tests you may have is a cerebrospinal fluid (CSF) analysis: Through a spinal tap or lumbar puncture, your doctor can check whether leukemic cells have spread to the fluid that surrounds the brain and the spinal cord.

Your doctor may also order chest X-rays to find signs of disease in the chest. To check for the effects of leukemia on bone tissue, you may need computed tomography (CT), popularly referred to as a CAT scan, or magnetic resonance imaging (MRI). Some types of leukemia tend to drill tiny holes into the bone. CT scanning shows radiologists the relative densities of bone tissues and helps to indicate where leukemia is affecting bone.

You may also need more lab tests. For instance, the creatinine/blood urea nitrogen (BUN) test measures kidney function.

Not all leukemias are staged. In childhood acute lymphocytic leukemia, for instance, the type of treatment depends not on staging, but on whether or not the youngster has been treated for leukemia before. A child being treated for the first time will most likely receive chemotherapy, while a child being treated for recurrent leukemia may have chemotherapy or a bone marrow transplant.

Conventional Treatment

Goals of Treatment

Is the condition curable?

Many leukemia sufferers experience remission of their leukemia symptoms. The disease can come back, however. The longer a leukemia stays in remission, and the fewer medications it requires to keep that leukemia in remission, the better the chances are for overcoming it.

Is there effective treatment available?

The effectiveness of a leukemia treatment depends on the type of leukemia being treated, the stage at which it is discovered, and its severity. There are several treatments available, including chemotherapy, radiation therapy, blood filtering procedures (leukapheresis), and surgery. Once the type of leukemia is determined (usually by bone marrow biopsy/aspiration), an appropriate treatment plan can be started.

Specific goals

- Detect the disease early.
- Identify the leukemic cells.
- Eliminate leukemic cells.
- Manage the deleterious effects of treatments.
- Monitor carefully for possible relapse.

Appropriate Health Setting

Treatment for acute leukemia requires patients to stay at a hospital. Treatment for chronic leukemia is often on an outpatient basis.

Healthcare Professionals Who May Be Involved in Treatment

Besides your family doctor/pediatrician, the following specialist physicians may be involved in your care:

- Radiologists
- Hematologists
- General surgeons
- Pathologists
- Medical oncologists (chemotherapists)
- Surgical oncologists
- Radiation oncologists (radiotherapists)
- Immunologists
- Medical geneticists
- Psychiatrists
- Clinical psychologists

Treatment Considerations

The treatment for leukemia is complex and varies from patient to patient. It depends on the type of leukemia, whether the leukemia is a relapse of a previous leukemia, and the extent of the disease. And, as with almost any disease, it also depends on the patient's age, general health, and symptoms.

Deciding which therapies are appropriate for you is a complex process that you and your doctor will undertake together. The therapy you choose depends upon the following:

- The type of leukemia you may have
- How far your leukemia has progressed
- Your general health
- Your age

Leukemia sufferers should seek treatment at a medical center that has a great deal of experience with leukemia, or perhaps a special leukemia department. If for some reason this is not possible, the treating physician should seek the advice of physicians from such a facility. Children can often be treated by very specialized doctors like pediatric hematologists or pediatric oncologists, who likely deal with childhood leukemia on a regular basis.

Cases of acute leukemia require immediate medical attention for their symptoms. Once the symptoms are stabilized, the leukemic cell type can be determined and a more precise treatment can begin in earnest. The types of chronic leukemia can be treated on a less urgent basis with regular visits to your doctor.

Your doctor will discuss with you the many forms of treatment for leukemia. Following is a brief discussion of these types of treatment.

Chemotherapy

Chemotherapy, the use of potent drugs to destroy the cancerous cells, is almost always used in the treatment of leukemia. Usually, a combination of drugs is used, but this depends upon the type of leukemia being treated. Some chemotherapy drugs can be taken by mouth, but most are given by intravenous (IV) injection. Sometimes, injection into the cerebrospinal fluid (CSF) is necessary to rid the body of leukemic cells in the central nervous system.

Chemotherapy is usually administered in cycles. In acute leukemia, there is first an intensive treatment period when very potent drugs are used. Chemotherapy itself has harmful (though necessary) side effects such as further reduction of blood cells, so supportive care with antibiotics, red blood cell transfusions, and platelet transfusions are often required. The goal of this intensive therapy is complete remission. Remission is generally defined as normal laboratory results and absence of symptoms.

Remission is not the same thing as cure, and leukemia will return if left untreated. Hence, chemotherapy is given in cycles. To prevent a relapse of leukemia, repeated intensive chemotherapy is often given in conjunction with radiation therapy and/or bone marrow transplant.

Radiation therapy (radiotherapy)

Radiation therapy is used to enhance the effectiveness of chemotherapy. The goal of radiotherapy is to use high-energy rays to damage leukemic cells and prevent them from dividing any further. If the leukemic cells are limited to a particular area, the radiation is directed just to that portion of the body.

Bone marrow transplant

For some patients, bone marrow transplantation is an option. Using intensive chemotherapy and radiotherapy, the leukemia sufferer's own bone marrow is destroyed. Then, it is replaced with healthy bone marrow. The healthy bone marrow can come from a donor or it can be the patient's own bone marrow stored before the radiotherapy and chemotherapy treatment. If the patient's own bone marrow is to be used, it is treated outside of the body to remove leukemic cells before being replaced.

Bone marrow transplantation requires that patients stay in the hospital (usually for several weeks) until the transplanted bone marrow begins producing a sufficient amount of its own blood cells. Transplant patients must be careful to avoid infections after surgery because their white blood cell count will be decreased. Bone marrow transplants can be difficult due to the difficulty of finding a suitable donor. Usually, a family member is a donor.

Biological therapy

Biological therapy is the use of substances that affect the immune system's response to leukemia. One such substance is interferon. Studies have shown that its use in conjunction with chemotherapy drugs may help slow the progression of chronic forms of leukemia and increase survival.

Leukapheresis

Leukapheresis is a supportive treatment for chronic myeloid leukemia (CML). It involves removing and separating abnormal or excessive white blood cells from the bloodstream. The blood goes through a filter that gets rid of abnormal cells, then the filtered blood returns to the bloodstream.

Activity Restrictions or Recommendations

Special precautions are necessary for leukemia patients due to the reduction of normal blood cells. It is advisable to plan regular rest periods throughout the day. Fatigue can occur in response to stress from leukemia treatment or as a result of anemia (decrease in red blood cells -- the cells that carry oxygen to tissues). Sleep at least eight hours a night and takes naps during the day if possible.

During treatment, it may be necessary to reduce the work day or discontinue work altogether for a time.

During and following treatment for leukemia, patients are still at risk for infection and bleeding. To prevent infection, avoid contact with human or pet feces. Avoid cleaning litter boxes and fish tanks. If you do get a wound that won't heal, a fever, chills, or other illness, contact your doctor immediately.

To prevent bleeding, it is necessary to avoid hazardous activities such as contact sports and carpentry. Use extra caution when gardening or handling pets that might scratch or bite you. Using a soft toothbrush will help prevent the gums from bleeding, and an electric shaver in place of a razor will help reduce another source of bleeding cuts. Finally, avoid tight clothing as this could impair the circulation.

Special Diets

Leukemia sufferers (especially acute leukemia sufferers) may experience loss of appetite/weight as a result of their disease. It is important to eat foods high in calories and protein to maintain your strength and prevent body tissues from breaking down. If you lose your appetite, try eating smaller meals frequently and throughout the day.

A bitter or metallic taste can also occur as a result of leukemia or its treatment. If this occurs, drink lots of fluids, such as fruit juices, tea, or water. Eating foods that leave their own taste (like hard sugarless candies and fresh fruits) may also help.

Drug Therapy

The most commonly used treatment in the care of leukemia is chemotherapy. Chemotherapy is the use of drugs to kill the cancerous cells and restore a normal ratio of healthy blood cells. Each drug therapy is tailored to the individual's leukemia type. A combination of drugs is usually necessary to effectively target and destroy the cancerous cells. Additionally, antibiotics may be added to your drug regimen to protect against infection since chemotherapy itself suppresses your body's natural response to infection.

Since the treatment of leukemia with chemotherapy is an area being researched extensively, the list of drugs used to treat this disease is evolving rapidly. Here are some of the more common drugs currently being used to treat leukemia:

Adrenocorticoids: help diminish the number of WBCs in the body.

- Prednisone (Orasone)

Alkylating agents: interfere with the production of WBCs.

- Busulfan (Myleran)

- Chlorambucil (Leukeran)
- Cyclophosphamide (Cytosan)
- Carmustine (BCNU)

Antibiotic antineoplastic drugs: help block the division of leukemic cells.

- Daunorubicin hydrochloride (Cerubidine)
- Doxorubicin
- Plicamycin (Mithracin)
- Idarubicin

Antimetabolite drugs: interfere with leukemic cell growth.

- Cytarabine (Ara-C)
- Cytosine arabinoside (Cytosar-U)
- Hydroxyurea (Hydrea)
- Mercaptopurine (Purinethol)
- Methotrexate (Rheumatrex)
- Thioguanine (Lanvis)

Miscellaneous antineoplastic drugs: help to stop abnormal cell growth in acute leukemia.

- Asparaginase (Elspar)
- Vincristine sulfate (Oncovin)
- Mitoxantrone (Novantrone)

Surgery

The primary surgery used to treat leukemia is bone marrow transplant. Bone marrow transplant (BMT) involves the complete destruction of the patient's own bone marrow using chemotherapy, with or without radiotherapy. Disease-free bone marrow is then injected into the veins. It finds its way into the bones and begins making its own blood cells in about two to four weeks.

One complication of bone marrow transplant surgery is graft-versus-host disease (GVHD). This occurs when a patient's immune system treats donated cells as foreign particles and mounts an immune response to them. Finding a suitable donor is crucial in bone marrow transplant surgery.

There are three types of bone marrow donors. They are as follows:

- **Autologous transplant:** involves the use of the patient's own bone marrow. It is removed from the bone marrow, treated outside the body, then replaced. This type of transplant avoids the problem of a graft-versus-host disease (GVHD) since the patient's own cells are

being reintroduced and will be recognized as such. However, there is a higher incidence of leukemia recurrence in these patients.

- **Syngeneic transplant:** involves donated cells from an identical twin. It also prevents GVHD since the cells being transplanted are of identical genetic make-up.
- **Allogenic transplant:** donors provide the transplanted bone marrow for this type of surgery. Usually, the donor is a parent or sibling whose marrow type closely matches the patient's type, but can also be an unrelated donor with a close bone marrow type match. This is to reduce the possibility of GVHD, which occurs in 30% to 50% of the patients who undergo treatment. This type of transplant is usually only recommended after a relapse of ALL.

Bone marrow transplants often save lives, but they are also expensive, technically complex, and potentially life-threatening themselves. A patient and his or her family should thoroughly understand the procedure and the alternative treatments before deciding to proceed.

After transplantation, you will receive antibiotics to prevent infection. You may be placed in a sterile room with a filtered air supply in order to prevent infection as well. For up to three or four weeks after the surgery, you may also require red blood cell transfusions to prevent anemia, as well as platelet transfusions to prevent bleeding.

Patients are usually discharged from the hospital about five to six weeks after the surgery. But even after that, it will take some time for your immune system to heal. Outpatient care continues after the surgery. Patients should plan to return to work in nine months to one year after the procedure.

Managing Leukemia Treatment

The care of a leukemia patient is normally headed by an oncologist (or, if the patient is a child, a pediatric oncologist). An oncologist is a doctor who specializes in the treatment of cancer. He or she has received special training in the treatment of cancers, as well as a certification after three or more years of training in the field.

All oncologists undergo continuing medical education throughout their careers, and most are associated with medical centers specially equipped for and experienced in the treatment of leukemia.

Though many physicians will be involved in your care, your oncologist will discuss with you the general course of your treatment and coordinate your care with other physicians as necessary.

Quality of Life

If you have just been diagnosed with chronic leukemia, chances are you did not know you had it in the first place. The quality of life you enjoy may be interrupted periodically by periods of intense treatment, during which your immune system will be lowered and fatigue may set in. Chronic leukemias tend to cause progressive fatigue, decreased exercise ability, shortness of breath, and headache. Additionally, easy bruising, gum bleeding, loss of appetite, and prolonged infections occur more and more frequently. Many other symptoms may occur. Be sure to ask your physician about these when they arise to find out whether they are related to your leukemia or not.

Once the most severe phase of an acute leukemia has passed, you will be able to resume living at home. There are guidelines you will have to follow in order to assure your continued health. In addition to dietary modifications, leukemia sufferers must avoid dangerous activities such as football or other activities that could cause bleeding or bruising.

The chemotherapy and radiation treatments often used in the treatment of leukemia can be very draining for patients. These treatments affect to some degree the growth and division of some normal cells in addition to the leukemic cells the treatments are designed to destroy. This is an unavoidable side effect of these treatment methods, and the effects of therapy on normal cells can cause a wide variety of symptoms. Unfortunately, these imperfect treatments are the best that modern medical science has to offer. Usually, the need to treat the disease is far outweighed by a treatment's harmful effects on the quality of life.

Considerations for Fertility

Radiation therapy and chemotherapy can cause women to become infertile. A woman's menstrual cycle can also become irregular or stop altogether. Postmenopausal women may have worsened symptoms of menopause, such as hot flashes and vaginal dryness.

In men, radiation and chemotherapy treatments can have a negative effect on male fertility. A man may stop producing sperm. This change may be temporary or permanent. It may be possible for men to freeze their sperm and have it stored prior to radiation or chemotherapy.

Because their sex glands are more resistant to treatment, children who receive chemotherapy or radiation therapy usually have normal fertility when they become adults. However, depending on the drugs used and the dosages given, some boys and girls may not be able to have children when they grow up.

Considerations for Children and Adolescents

Children can cope with just about anything if they know their parents are at their side. It is important to explain as much as possible to your child. For a sick child and his brothers and sisters to feel secure, they must be able to depend on their parents to tell them the truth, whether it is good

news or bad.

During the treatment of leukemia, parents are often filled with feelings of sadness, shock, anger, confusion, and even guilt. Though you shouldn't allow these natural responses to overpower you, it is important to recognize them and not sweep them under the carpet. Rather than suppressing your natural feelings, find healthy ways of expressing them.

It is just as important to remember that children, both siblings and the ill child, are also overcome with strong feelings. But children have fewer emotional skills and may not be able to handle their feelings as well. Be sensitive to this and help your child or children understand their emotions.

Current Therapies Available

- Chemotherapy
- Radiation Therapy
- Bone Marrow Transplant
- Biological Therapy
- Leukapheresis

Alternative Treatments

Leukemia is a serious illness that requires the most sophisticated treatments medicine has to offer. However, a few alternative treatments may be helpful to your well-being.

Vitamins, minerals, and other supplements

Most healthcare professionals agree that while certain supplements can be of use in treating cancer, nutrients are best obtained by eating a healthy diet. Look for foods high in beta carotene and vitamins C and E. Good choices are dark green vegetables, yellow and orange fruits, citrus fruits and bell peppers, wheat germ, seafood, legumes, and poultry.

Herbal remedies

- Madagascar periwinkle (use only under doctor's supervision)
- Ginger (to reduce nausea)
- Ginseng (to reduce nausea)
- Sarsaparilla (to reduce nausea)
- Wild Oregon grape (to reduce nausea)
- Garlic pills (may bolster immune system)
- Royal jelly (preventive substance)

Yoga/Meditation/Relaxation Techniques

The regular practice of stress reduction techniques can do a lot to relieve the anxiety related to leukemia. Studies have shown that reducing stress helps strengthen the immune system.

Group Support

There are many support groups for those with leukemia and parents of children that have leukemia. These support groups can be an invaluable aid in educating you about leukemia as well as providing emotional support through the experience and expertise of others that are going or have gone through leukemia.

Listed below are some organizations that can help you find a leukemia support group in your area. Also, check your local phone book for these organizations.

- The Leukemia Society of America (800) 955-4572
- Candlelighters Childhood Cancer Foundation (800) 366-2223
- The Cancer Information Service (800) 422-6237
- The American Cancer Society (800) 422-6237

Some people may be uncomfortable with the idea of joining a support group: those who do not wish to join an organized support group may also find comfort and support from friends and family, or from individual counseling with a therapist experienced in working with cancer patients.

Self Care & Prevention

Preventing Leukemia

Prevention of leukemia is limited to reducing one's risk factors for the disease. An important step you can take to reduce the chances of leukemia is to stop smoking, as this activity has been related to acute leukemias. Other risk factors include physical and chemical factors. Avoid long-term or high-level exposure to chemicals such as benzene (a chemical found in gasoline), and radiation (possibly power plants).

Self-Care Measures

- **Create a positive environment.** Though the physical properties of your environment may not make a difference in leukemia, the psychological ones most certainly do. Surround yourself with family, friends, and other positive stimuli. Make your environment a place that will promote happiness and better your health.

- **Reduce fat, increase fiber.** The American Cancer Society recommends a diet low in animal fat and high in fiber. Specifically, you should have five servings of fruits and vegetables daily, along with six servings of other plant foods such as breads, cereals, grains, rice, pasta, and beans. Omega-3 fatty acids may be beneficial as well. They can be found in fish such as salmon and mackerel, as well as flaxseed and canola oils.
- **Get plenty of veggies.** Some nutritionists recommend increasing the amount of tomatoes, broccoli, green peas, celery, kale, garlic, and green or black tea (not decaffeinated) in your diet. In addition, you may want to consider reducing your intake of partially hydrogenated oils like the ones found in most snack crackers -- research has linked them to increased risk for cancer.
- **Be flexible.** The course of leukemia can be very different from one person to another. The lifestyle you lead will depend in part upon the nature of your leukemia. Many leukemia sufferers overcome their disease in spite of the physical and emotional barriers it presents, often adapting new ways of living that result in a richer life experience than before they were ever diagnosed with the disease.
- **Think positive.** Keeping a positive outlook is a helpful step toward helping your body overcome leukemia. A clear, optimistic mind is the one best suited to lead you through disease.
- **Seek group support.** There are many support groups for those with leukemia and parents of children that have leukemia. These support groups can be a valuable aid in educating you about leukemia as well as providing emotional support through the experience and expertise of others that are going or have gone through leukemia.

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Resources

Websites & Organizations

American Cancer Society
1599 Clifton Road NE
Atlanta, GA 30329
Phone: 800-ACS-2345 (800-227-2345)

American Society of Clinical Oncology
225 Reinekers Lane, Suite 650
Alexandria, VA 22314
Phone: 703-299-0150
Fax: 703-299-1044
Email: asco@asco.org

Cancer AnswerLine
800-865-1125

Cancer Care Inc.

Leukemia Society of America
600 Third Avenue
New York, NY 10016
Phone: 212-573-8484
Info. Resource Center phone: 800-955-4LSA (800-955-4572)

Medicine Online

National Cancer Institute
National Institutes of Health
Bethesda, MD 20892
Phone: 301-496-4000 or 800-4-CANCER (800-422-6237)

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