

Highlights

- Treatments for adults with leukemia, lymphoma, myeloma, myelodysplastic syndromes and myeloproliferative neoplasms (blood cancers) have led to increased survival rates. However, some treatments may cause significant long-term or late effects.
- Follow-up medical care to monitor survivors for possible long-term or late effects is important. Patients should discuss possible effects of treatment with their healthcare providers in order to plan treatment and follow-up care.
- Factors that determine the risk of long-term or late effects include the type and length of treatment, the person's age at the time of treatment, gender and overall health.
- Patients may need to educate family members and friends about the challenges of long-term and late effects.
- Survivorship care plans are an important part of a long-term health plan. There is value in creating and using these plans for lifelong benefits.
- Long-term and late effects of treatment are important, ongoing areas of study for all therapies. Researchers are working to improve the understanding of long-term and late effects and to create guidelines on follow-up care. Data for many therapies are limited at present. Patients may be able to contribute to this important research by taking part in studies (clinical trials) to collect data on long-term or late effects, or by completing questionnaires about their health during maintenance therapy or after treatment ends.

Introduction

Cure rates and remission periods for adults with leukemia, lymphoma, myeloma, myelodysplastic syndromes and myeloproliferative neoplasms (blood cancers) have greatly improved because of

- New drugs
- New uses for existing drugs
- Improvements in radiation therapy and stem cell transplantation techniques.

Research to improve health outcomes for more patients is ongoing. Doctors are working to tailor therapies to decrease side effects and long-term and late effects.

Survivors of blood cancers do not always have serious long-term or late effects of treatment. Effects can range from mild to severe. However, it is important to talk about possible long-term and late effects with your treatment team to plan treatment and follow-up care. The risk for developing long-term or late effects may be influenced by

- The type and duration of treatment
- The patient's age at the time of treatment
- The patient's gender
- The patient's overall health.

This fact sheet is about long-term and late effects in adults treated for blood cancers. Please see The Leukemia & Lymphoma Society's (LLS) free publication, *Long-Term and Late Effects of Treatment for Childhood Leukemia or Lymphoma Facts* for additional information.

Long-Term and Late Effects

"Long-term effects" of cancer therapy are medical problems that last for months or years after treatment ends. Fertility problems and treatment-related fatigue are examples of long-term effects.

"Late effects" are medical problems that do not show up or get noticed until years after treatment ends. Treatment-related cancer and heart disease are examples of late effects.

Long-term and late effects for survivors of blood cancers may include

- Effects on thinking, learning and memory, called "cognitive effects"
- Physical effects
- Psychological effects.

Cognitive Effects

Cancer treatments such as chemotherapy and radiation therapy can cause problems with mental functions, such as concentration, memory and the ability to multitask (to keep track of and do different tasks at the same time). These effects are sometimes referred to as “chemo brain” or “brain fog.”

Physical Effects

Depending on the type and duration of treatment and individual risk factors, including genetics and overall health, adults may be at risk for

- Heart or thyroid problems
- Hearing loss
- Secondary cancer
- Loss of fertility
- Other conditions.

Psychological Effects

Some individuals may experience long-term psychological effects after treatment ends, including depression or posttraumatic stress disorder.

The cognitive, physical and psychological effects of cancer treatment can affect the everyday activities of survivors. Support and help are available for cancer patients and survivors, who may face

- Job discrimination
- Difficulty getting health or life insurance
- Financial issues
- Relationship or social problems
- Lack of follow-up care.

For additional information, please see the *Resources* section on page 6.

Managing Long-Term and Late Effects

Cancer survivors may need to educate family members, friends, and healthcare providers about long-term and late effects.

Here are some suggestions for patients and survivors:

- Keep a record of any physical or emotional symptoms that you experience and discuss them with your treatment team.
- Keep all medical records, including dates and locations of cancer treatment; drugs and supportive therapies (e.g., blood transfusions) and dosages; and specific sites and amounts of radiation therapy, if applicable. Keep a copy of blood, marrow and imaging test results (MRIs, CT scans, x-rays).

- Keep a list of all the medicines you take, and update the list as needed. It is important that all members of your care team know all medicines you are taking. If you have an allergy to a medicine, make sure you note that too.
- Ask your doctor for a written summary of the cancer treatment that you received, including names of all drugs used, whether or not radiation was used, what type of surgical procedures were performed and whether you experienced any unusual or especially severe or acute complications of cancer therapy. This summary is called a survivorship care plan. You can read more about this below in the *Follow-up Care* section.
- Follow a health plan that includes being active, using sun protection and eating healthy foods. Do not smoke or use tobacco products. If you do, healthcare professionals can offer information or refer you to resources to help you quit.
- Keep medical follow-up appointments.
- Stay informed. Ask your treatment team for the latest information on long-term and late effects of cancer treatment or contact an LLS Information Specialist.

Follow-up Care

Medical follow-up care gives doctors the chance to

- Monitor disease response to current or past treatments over a period of time
- Identify recurrence of the disease, if any
- Detect long-term or late effects.

Cancer survivors should see their primary care doctors for general health and physical examinations yearly or more often, as needed.

They should see their oncologists for follow-up cancer care. Regular examinations may include screening for cancer recurrence, for the development of a secondary cancer or for other late effects of treatment.

A survivorship plan or follow-up plan should be developed by a patient’s oncologist to help monitor for late effects. This can help the patient’s primary care doctor who might not be familiar with possible problems. These plans are individualized and long-term. It is helpful for a patient to be seen yearly at a long term follow-up clinic specifically for cancer survivors along with regular visits to a primary care doctor.

Coordination between oncologists and primary care doctors is important to provide the best care possible.

Some treatment centers have follow-up cancer care clinics,

which provide a complete, multidisciplinary approach for cancer survivors. Most follow-up clinics specialize in helping pediatric cancer survivors, but some work with adult cancer survivors.

You can find information about survivorship plans and guidelines and follow-up clinics for survivors of cancer by visiting the *Resources* section on page 6.

Examples of Long-Term and Late Effects

Possible long-term or late effects of treatment are described below. Talk to your doctor about the actual risks for you.

Treatment for blood cancers usually includes chemotherapy and/or other drug therapies. Patients may receive radiation therapy, stem cell transplantation or splenectomy. Certain risks for long-term and late effects are common to all of these treatments. For additional information, please see the free LLS publication, *Blood and Marrow Stem Cell Transplantation*.

Drug Therapy

A number of chemotherapy and other drugs are used to treat blood cancers.

Alkylating drugs have been associated with heart and lung problems, risk for secondary cancers, low testosterone levels and sperm counts in men and premature ovarian failure (POF) or premature menopause in women. The combination of alkylating drugs and radiation therapy increases the risk of fertility problems.

Examples of alkylating drugs are

- Cyclophosphamide (Cytosan®), which can increase the risk for chronic heart failure, myelodysplastic syndromes and acute myeloid leukemia.
- Procarbazine (Matulane®), nitrogen mustard (Mustargen®), and ifosfamide (Ifex®), which can increase the risk for myelodysplastic syndromes and acute myeloid leukemia.
- Carmustine (BiCNU®) and busulfan (Myleran®), which can increase the risk for scarring and inflammation of the lungs.
- Carboplatin (Paraplatin®) and cisplatin (Platinol®), which can increase the risk for hearing loss and peripheral neuropathy or contribute to heart damage. Sometimes kidney function can be affected.

Anthracyclines, which have been associated with heart damage (e.g., heart muscle injury, chronic heart failure). Heart muscle damage is usually related to the cumulative

dosage of anthracyclines, many of which are used to treat acute myeloid leukemia. Anthracyclines include doxorubicin (Adriamycin®), idarubicin (Idamycin®), and daunomycin (Cerubidine®).

Anthracycline drugs may also increase the risk of developing a secondary cancer, such as acute myeloid leukemia or myelodysplastic syndromes.

Bleomycin (Blenoxane®) is an antitumor antibiotic drug therapy commonly used to treat germ cell tumors and lymphoma that, when used in high dosages, can potentially result in acute respiratory distress syndrome and lung failure.

Bortezomib (Velcade®) is a proteasome inhibitor used to treat persons with myeloma. It has been associated with peripheral neuropathy, which can be characterized by numbness, pain or tingling in the hands or feet.

Corticosteroids, which have been associated with osteoporosis and cataracts. High dosages of corticosteroids may be associated with avascular necrosis, which is weakening of the bone in the hip(s). Corticosteroids have been used to treat individuals with leukemia, lymphoma and myeloma. Prednisone and dexamethasone are examples of corticosteroids.

DNA repair enzyme inhibitors, which are derived from toxins found in certain plants, can cause acute myeloid leukemia and myelodysplastic syndromes. Etoposide (Etopophos®) and teniposide (Vumon®) are examples of this class of drugs.

Drugs that prevent the cells from dividing by blocking mitosis, such as vincristine (Oncovin®) and vinblastine (Velban®), have been associated with peripheral neuropathy.

Immunomodulators modify or influence the functions of the immune system. Thalidomide (Thalomid®) and lenalidomide (Revlimid®), which are used to treat persons with myeloma, have been associated with peripheral neuropathy.

Methotrexate is used to treat leukemia and lymphoma; it has been associated with osteoporosis and lung damage. Intrathecal and intravenous methotrexate can cause cognitive impairment.

Radiation Therapy

Radiation therapy is the use of ionizing radiation to kill cancer cells. For some individuals, radiation therapy to the head and neck may lead to

- Problems with thinking, learning or memory, called “cognitive effects”

- Brain or thyroid cancer
- Hypothyroidism or hyperthyroidism
- Dental abnormalities such as dry mouth or cavities
- Hearing loss
- Vision problems such as cataracts or glaucoma
- Osteoporosis (bone thinning).

Radiation therapy to the chest can cause

- Lung damage (scarring, inflammation, breathing difficulties)
- Heart damage (scarring, inflammation, coronary heart disease)
- Osteosarcoma
- Breast or thyroid cancer
- Hypothyroidism or hyperthyroidism.

Total body irradiation for individuals undergoing a hematopoietic stem cell transplant can potentially cause gonadal failure and fertility issues in both men and women.

High-dose radiation to the spleen can increase the risk that survivors will develop repeated bacterial infections.

Local radiation therapy may also have effects on fertility depending on what part of the body is radiated.

Splenectomy

Surgical removal of the spleen (splenectomy) may be used to treat certain individuals with leukemia or lymphoma. A splenectomy may result in impaired immune system functions, increasing a person's susceptibility to bacterial infections and other conditions.

Data has not been collected for a long enough time period for the long-term and late effects of newer drugs to be identified. Talk to your doctor for more information.

Treatment Under Investigation

Research for long-term and late effects continues to increase. Patients may have the opportunity to take part in clinical trials. These trials, conducted under rigorous guidelines, help clinicians and researchers to determine the beneficial and adverse effects of potential new treatments. Studies are also conducted to evaluate new indications for therapies that are already approved for other diseases.

In addition, research to better understand and treat long-term and late effects associated with certain cancer

therapies is ongoing. Researchers are also studying ways to lessen or minimize the negative impact of existing therapies. Current research seeks to understand how factors such as aging and socioeconomic status influence long-term and late effects.

LLS is funding research to understand the effects of transplantation versus alternative treatments on a patient's survival and quality of life; measure quality of life and physical function in patients being treated with intensive chemotherapy; obtain measures of cognitive functioning as patients return to work following bone marrow transplantation; identify individuals prone to developing certain cancers after chemotherapy or radiation therapy to allow doctors to potentially modify the type of therapy; identify mutations and their biological impact in certain cancers to help create new therapies; and analyze the effects of vorinostat on human immune cells and test it as an additional treatment option to standard therapy of graft-versus-host disease.

For more information about clinical trials, see the free LLS publication *Understanding Clinical Trials for Blood Cancers*, visit www.LLS.org/resourcecenter or call our Information Specialists.

Glossary of Cancer Treatment Effects

You may see or hear some of the following terms. However, not all terms will apply to your treatment or treatment effects.

Avascular necrosis is a condition in which the blood vessels that nourish the bones die, causing parts of the bone to weaken or collapse.

Chemo brain is a term used to explain a condition of confusion, forgetfulness or memory loss that many survivors describe. Patients who experience cognitive effects should be evaluated. Chemo brain is not the same as depression or fatigue. All three conditions may produce some of the same effects, but these three conditions may require different treatments.

Fatigue, or tiredness, that lasts and does not improve with rest can continue for months or years following treatment. Fatigue can make it hard to do daily tasks or to concentrate. For more information, see the free LLS publication, *Cancer-Related Fatigue Facts*.

Fertility refers to the ability to become pregnant or father a child. Survivors of leukemia or lymphoma treated with modern conventional therapy are at relatively low risk for fertility problems. Most go on to have normal fertility and healthy offspring. However, a small number of survivors are unable to have children. Certain drugs can harm sperm

production; however, production may resume months or years after treatment.

Hypothyroidism refers to lower-than-normal activity of the thyroid gland. The symptoms may include increased sensitivity to the cold, weight gain, painful joints, muscle aches, and pale, dry skin. Hypothyroidism is more common than hyperthyroidism.

Hyperthyroidism refers to higher-than-normal activity of the thyroid gland. The symptoms include nervousness, sudden weight loss, rapid heartbeat, fatigue and an increased sensitivity to heat.

Osteoporosis is a condition of decreased bone density that leads to thin bones and increased risk for fractures.

Peripheral neuropathy causes numbness, tingling or pain in the hands and feet. It may last for months or years following treatment with certain drugs that harm the nerves. The peripheral nerves are found outside the central nervous system (brain and spinal cord).

Premature ovarian failure (POF) describes a stop in normal ovarian function in a woman younger than age 40. Unlike menopause, this is not a natural occurrence. When POF is caused by cancer treatment, it is unlikely that a girl or woman will have menstrual periods or have the ability to become pregnant. Generally, POF is managed with hormone replacement therapy, including estrogen and progesterone and sometimes also testosterone. Girls and women with POF are encouraged to eat a healthy diet and exercise regularly (aerobics and weight training) to decrease health risks of osteoporosis and heart disease. Supplements or medications for bone health may be prescribed. At this point, there is no treatment to restore fertility for someone diagnosed with POF. Medications can be prescribed to assist with managing POF and regulating hormones.

Second cancers can develop in certain cancer survivors treated with chemotherapy or radiation therapy. These survivors are at somewhat higher risk for developing a second cancer compared to the general population. The risk is greater for younger patients and increases with higher total dosage of radiation. Cancer treatment may not be the only reason that some survivors develop second cancers. Genes or gene-environment interactions may also be factors for increased risk in some patients. Examples of second cancers are

- Acute myeloid leukemia and myelodysplastic syndromes – Treatment-related acute myeloid leukemia/myelodysplastic syndromes may occur in some people who received treatment with alkylating drugs or DNA-repair-enzyme inhibitors.

- Brain tumors – Treatment with cranial radiation can increase the risk of developing a brain tumor.
- Breast cancer – Women who have received mantle radiation therapy for Hodgkin lymphoma have an increased risk for breast cancer. Women treated before the age of 21 years have a significantly greater risk than adult women. Younger women should receive annual mammograms and biannual breast exams, starting at 10 years after receiving treatment.
- Osteosarcoma – Patients who have received mantle radiation therapy for Hodgkin lymphoma have an increased risk for osteosarcoma, the most common type of bone cancer. The risk for osteosarcoma depends on the dosage of radiation and whether individuals were concurrently treated with alkylating drugs.

Sexuality refers to physical, psychological, social, emotional and spiritual factors. Both men and women may have some sexual effects during and after treatment. Men may experience difficulty maintaining an erection, have low sperm counts or become sterile. Women may fail to ovulate or conceive, have irregular periods, experience painful intercourse, and develop early menopausal signs such as hot flashes, insomnia and increased irritability. For more information, please see the free LLS publication *Sexuality and Intimacy*.

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Ellin Berman, MD

Professor of Medicine, Hematology/Oncology
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New York, NY

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We're Here to Help

LLS is the world's largest voluntary health organization dedicated to funding blood cancer research, education and patient services. LLS has chapters throughout the country and in Canada. To find the chapter nearest you, enter your ZIP code into "Find your Chapter" at www.LLS.org or contact

The Leukemia & Lymphoma Society

3 International Drive, Suite 200
Rye Brook, NY 10573

Information Specialists: (800) 955-4572

Email: infocenter@LLS.org

Callers may speak directly with an Information Specialist Monday through Friday, from 9 a.m. to 6 p.m. ET. You may also contact an Information Specialist between 10 a.m. and 5 p.m. ET by clicking on “Live Chat” at www.LLS.org or by sending an email. Information Specialists can answer general questions about diagnosis and treatment options, offer guidance and support and assist with clinical-trial searches for leukemia, lymphoma, myeloma, myelodysplastic syndromes and myeloproliferative neoplasms. The LLS website has information about how to find a clinical trial, including a link to an online clinical-trial search service.

LLS also provides free publications that can be ordered via the 800 number or through the “Free Education Materials” option at www.LLS.org/resourcecenter.

Resources

Federal and state laws. These laws, such as the Americans with Disabilities Act (ADA), protect qualified cancer survivors from job or insurance discrimination. For more information, visit the ADA website at www.ada.gov and the Cancer Legal Resource Center at www.disabilityrightslegalcenter.org/about/cancerlegalresource.cfm.

Vocational rehabilitation. Many states offer vocational rehabilitation services to qualified individuals. Eligibility and services vary by state. The Office of Special Education and Rehabilitative Services has a list of state offices at www2.ed.gov/about/contacts/state/index.html?src=ln.

Community support groups. These local groups offer support and networking opportunities. The National Cancer Institute has advice on finding community resources at www.cancer.gov/cancertopics/factsheet/Support/resources.

Cancer.net

www.cancer.net

Cancer.net provides oncologist-approved information to help individuals and families make informed healthcare decisions.

Centers for Disease Control and Prevention (CDC). Cancer Prevention and Control, Cancer Survivorship.

www.cdc.gov/cancer/survivorship

CDC works with public, nonprofit, and private partners

to create and implement strategies to help the millions of people in the United States who live with, through, and beyond cancer.

LIVESTRONG

www.livestrongcareplan.org/

- LIVESTRONG provides The LIVESTRONG Care Plan, a “survivorship care plan” that is individualized based on the answers provided in a brief questionnaire.
- A list of NCI-designated Comprehensive Cancer Centers which are members of the Livestrong Survivorship Center of Excellence Network. www.livestrong.org/What-We-Do/Our-Actions/Programs-Partnerships/LIVESTRONG-Survivorship-Centers-of-Excellence

National Cancer Institute (NCI). Office of Cancer Survivorship.

<http://dcccps.nci.nih.gov/ocs>

The mission of the Office of Cancer Survivorship (OCS) is to enhance the quality and length of survival of all persons diagnosed with cancer and to minimize or stabilize adverse effects experienced during cancer survivorship. OCS conducts and supports research that both examines and addresses the long- and short-term physical, psychological, social, and economic effects of cancer and its treatment among pediatric and adult survivors of cancer and their families.

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