LEUKEMIA & LYMPHOMA SOCIETY®

External Beam Radiation Therapy

No. 38 in a series providing the latest information for patients, caregivers and healthcare professionals

Highlights

- Radiation therapy uses high energy x-rays or other types of radiation to kill cancer cells.
- External beam radiation, the most commonly used type of radiation therapy, delivers radiation from a machine outside the body to target cancer cells.
- Radiation therapy is often used along with other treatments such as drug therapy, stem cell transplantation or surgery.
- Radiation therapy can also be used to relieve symptoms of blood cancer, such as bone pain.
- Total body irradiation (TBI) may be given to prepare for a stem cell transplantation.
- Although radiation is directed at cancer cells, it can also damage healthy cells within the radiation treatment area. This can cause side effects, but doctors use special techniques to minimize damage done to nearby tissues and healthy cells.

Introduction

Radiation therapy, also known as "radiotherapy," uses high energy x-rays or other types of radiation to kill cancer cells. While most blood cancers cannot be cured with radiation therapy alone, doctors may combine it with other treatments such as chemotherapy, immunotherapy and stem cell transplantation. Radiation therapy may also be used to relieve symptoms of blood cancer and improve quality of life. External beam radiation therapy (EBRT) is the most common type of radiation therapy used to treat blood cancers.

How Radiation Therapy Works

At high doses, radiation therapy kills cancer cells by damaging the DNA inside the cancer cells. Cancer cells with damaged DNA stop replicating and/or die. Nearby, healthy cells can also be affected by radiation, but most can repair much of the damage caused by radiation and recover. Doctors plan treatments so that radiation damages the cancer cells while, as much as possible, minimizing potential harm to nearby healthy cells.

External Beam Radiation Therapy

External beam radiation therapy delivers radiation from a machine outside of the body to target cancer cells. The machine moves around the body to deliver radiation from various angles.

External beam radiation therapy is usually a "local treatment." This means that it is directed at the specific part of the body where the cancer is located; therefore, it only affects that area of the body. For example, a patient with a lymphoma mass in the chest will have radiation therapy only to specific areas in the chest and not to the entire body.

Total body irradiation (TBI) that delivers treatment to the whole body may be used to prepare a patient for a stem cell transplantation. (See *Total Body Irradiation* on page 3.) In some cases, total skin electron beam therapy can be used to treat large areas of the body for patients with cutaneous T-cell lymphoma with widespread skin lesions. (See *Total Skin Electron Beam Therapy* on page 3.)

The type and dose (total amount) of radiation used during treatment depends on the disease and goal of treatment. A radiation oncologist will determine the dose. A radiation oncologist is a doctor who specializes in giving radiation therapy to treat cancer.

External beam radiation does not make you radioactive. You cannot expose others to radiation so it is safe to be in close contact with other people after a radiation treatment.

Types of Beams Used in External Beam Radiation Therapy

Photons. Photon radiation beams are used during x-ray imaging but at lower doses than the doses used for electron beam radiation therapy. Photon beams can travel deep into the body to reach the cancer. The beams can also spread bits of radiation along their path and damage healthy tissue, both in front of and behind the cancer. Your treatment team will take steps to minimize damage to healthy tissues. A machine called a "linear accelerator" ("linac" for short) delivers the photon beams (see **Figure 1** on page 3).

Electrons. Electrons are particles with a negative charge. Electron beams do not travel very far through the body so these beams are used to treat cancers on the skin or near the surface of the body. Since electrons do not penetrate deeply into the body, they are less likely to harm the tissue and organs beneath the skin. Electron beam radiation therapy, like photon beam radiation therapy, is also produced by a linear accelerator. This type of radiation therapy is often used to treat cutaneous T-cell lymphoma and superficial (on the surface) skin conditions.

Protons. At some cancer centers, proton beam radiation may be an option. However, proton therapy does not replace other therapies and not all patients need proton therapy. Protons are particles with a positive charge. Proton beam radiation can be more targeted than photon beam radiation. This helps to minimize radiation to healthy tissues and organs. This type of radiation therapy is newer and requires the use of a special machine called a "synchrotron" or "cyclotron."

How External Beam Radiation Is Used in Blood Cancer Treatment

Radiation therapy is usually part of a treatment plan that includes chemotherapy or other drug therapy. Radiation therapy may be used to:

- Treat localized lymphoma masses
- Prepare for a stem cell transplantation
  - o See *Total Body Irradiation* on page 3.
- Shrink an enlarged spleen, liver or lymph nodes
- Manage pain from bone damage caused by cancer cells growing in the bone marrow
- Treat leukemia that has spread outside the bone marrow and blood, to the central nervous system (brain and spinal cord), for example
- Treat skin lesions for patients with cutaneous T-cell lymphomas, such as mycosis fungoides and Sézary syndrome
- Treat solitary plasmacytoma (a single tumor, formed by plasma cells, that may develop into myeloma)

Talk to members of your healthcare team about how radiation therapy may be part of your treatment plan. Not all blood cancer patients will receive radiation therapy.

Before Treatment

Before your radiation therapy begins, your treatment has to be planned. You will prepare for treatment with a "simulation" appointment. During the simulation, members of your treatment team will determine how to direct the radiation and position you during treatment. Imaging, such as a computed tomography (CT) scan, positron emission tomography (PET) scan or magnetic resonance imaging (MRI), may help guide your treatment team. During treatment, it is important that you are positioned in exactly the same way during each appointment to make sure that the correct amount of radiation is delivered to the exact same area in order to:

- Target the part of the body that needs to be treated
- Minimize radiation to healthy organs and tissues

Your treatment team may mark your skin to ensure the radiation is aimed at the same part of your body during each treatment. These marks are small dots usually made with semipermanent ink. Your treatment team may cover the marks with a thin, transparent dressing, similar to a sticker. Be careful not to wash off the marks. In some cases, small permanent tattoos may be used to mark your skin. Permanent markings can be an advantage because your doctor will be able identify the exact area of treatment if you need more radiation therapy in the future. Talk to your treatment team about what type of markings will be used.

Instead of marking the skin, your treatment team may mark an immobilization device—a mold, cast or similar object—used to help you stay still during treatment. Molds can be used around your body to support your arms and legs so that you are as comfortable as possible. Patients undergoing head or neck radiation therapy are generally immobilized with masks. Masks are custom made from a soft, breathable mesh that is fitted to the patient's head and then hardens. If you are claustrophobic or uncomfortable, let the members of your treatment team know so they can help to make you more comfortable.

During Treatment

During each radiation treatment, you will be placed in exactly the same position that you were in for the simulation. You will be alone while the radiation therapist operates the machine from a nearby room. The radiation therapist can still hear you and see you through a window or camera. You can talk to them during the treatment. They may also talk to you to provide instructions, if needed.

Treatments are typically done once a day, 5 days a week (Monday through Friday), for a period of 2 to 4 weeks. Most visits last 30 minutes in the treatment room, even though actual radiation exposure lasts only a few minutes.

Most of the time is spent setting up and making sure you are in exactly the right position.

Do not wear jewelry, metal, lotions, creams or powders in the area being treated.

You will not see or feel the radiation beams. You should not feel any pain during the treatment session. However, you will need to stay in one position for several minutes, which may be uncomfortable.

Figure 1. Linear Accelerator and Patient

Figure 1: A linear accelerator (linac) is the machine most often used to deliver external beam radiation therapy.

Total Body Irradiation

Total body irradiation (TBI) may be used to prepare for a stem cell transplantation. To prepare for a stem cell transplantation, patients receive a conditioning regimen consisting of high-dose chemotherapy and sometimes TBI. The conditioning regimen is designed to:

- Destroy cancer cells throughout the body
- Destroy blood-forming cells in the bone marrow to create space for the new, healthy stem cells
- Suppress the patient's immune system to prevent rejection of new stem cells (if the patient receives stem cells from a donor)

During total body irradiation, small doses of radiation are delivered to the entire body to destroy cancer cells throughout the body. Treatment is administered in several divided daily doses to minimize side effects. Treatments are usually given 1 to 3 times a day over 2 to 4 days immediately before transplantation.

An extra dose of radiation (a boost) may be given to certain areas of the body. The treatment depends on the disease. For example, some men who have leukemia or lymphoma may receive a "boost" or an extra dose of radiation to their groin area to kill cancer cells that may be hidden in the testicles.

Visit www.LLS.org/booklets to view *Blood and Marrow Stem Cell Transplantation*.

Total Skin Electron Beam Therapy

Total skin electron beam therapy can treat the entire surface of the skin. It is appropriate for patients with cutaneous T-cell lymphoma, such as mycosis fungoides and Sézary syndrome, who have widespread thick plaques, either with or without skin tumors. During treatment, the patient stands on a platform that rotates so that the entire surface of the patient's skin can be treated from different angles. Usually, receiving the radiation just takes a few minutes. Typically, treatment is given a few times each week over a period of 3 to 4 weeks.

Visit www.LLS.org/booklets to view *Cutaneous T-Cell Lymphoma*.

Side Effects

Radiation therapy can damage normal cells as well as cancer cells. Some healthy tissue near the cancer cells may be damaged during the treatment, causing side effects. Most side effects are temporary and generally disappear over time once treatment has ended. However, some side effects may appear months or years later. See *Late Effects* on page 4. People can have different side effects from radiation therapy so it is important to talk to your radiation team about possible side effects and how to manage them.

Common general side effects of external beam radiation therapy are:

- **Fatigue.** "Fatigue" is a term used to describe feeling tired and worn out.
- **Skin problems.** Skin changes, such as dryness, redness, itching, blistering, or peeling, on the area of the body being treated. (Some patients say skin changes feel and look similar to a sunburn.) Fingernails and toenails can also become brittle or fall out if fingers or toes are in the area being treated. New ones will eventually begin to grow back.
- **Hair loss.** Hair loss or thinning can occur in the area being treated. For example, radiation to the head may cause loss of hair on the head, but radiation treatment to the chest may cause loss of hair on the chest but not on the head.

Other side effects are likely to be associated with the area of the body being treated.

Treatment Area	Possible Side Effects
Head and neck	Dry mouth, mouth sores, difficulty swallowing, hair loss, tooth decay, stiff jaw, cognitive (thinking/memory) changes, hearing loss, thyroid problems
Chest	Difficulty breathing, stiff shoulders, radiation pneumonitis (signs and symptoms include cough and fever) that can lead to scarring of the lungs called "radiation fibrosis," heart disease
Stomach and abdomen	Loss of appetite, nausea and vomiting, cramps, diarrhea
Pelvis	Diarrhea, rectal bleeding, loss of bladder control, sexual dysfunction (erectile dysfunction or vaginal dryness), infertility

Side effects that occur during treatment often begin to improve shortly after treatment ends. Skin changes usually peak 2 weeks after the last treatment session and then the condition of the skin begins to improve. Hyperpigmentation (darkened patches on the skin) and joint stiffness can persist after treatment ends. Talk to your treatment team about how to manage side effects.

Visit www.LLS.org/booklets (filter by "Side Effect Management") to view the full side-effect management series.

Late Effects

Some side effects, known as "late effects," may occur months or years after treatment ends. Depending on the area of the body treated, these can include:

- Skin discoloration, decreased elasticity
- Cognitive (thinking/memory) changes
- Dental problems, including tooth decay
- Hearing loss
- Less active thyroid gland
- Heart disease
- Infertility
- Secondary cancer (development of another cancer)

Patients who may want to have children after radiation treatment may be able to take steps to preserve fertility before treatment begins by sperm banking or egg or embryo (fertilized egg) freezing. In some cases shields can be used during treatments to protect the testes or ovaries from radiation.

Visit www.LLS.org/booklets to view *Fertility and Cancer* to learn more.

Another late effect of radiation therapy is a secondary cancer which is a new and different type of cancer than the first one. For example, radiation therapy to the chest can increase the risk of breast cancer so the patient may require additional and/or early screening for breast cancer.

Talk to your healthcare team about your risk for late effects and how you will be monitored for them. Ask for a written plan.

LLS offers a free survivorship workbook, called *Navigating Life During and After a Blood Cancer Diagnosis*. Use the book to collect all the important information you need as you move through diagnosis, treatment, and follow-up care or into long-term management of a chronic blood cancer. There is a version of the workbook for adults, young adults and children/adolescents.

Visit www.LLS.org/SurvivorshipWorkbook to learn more.

Caring for Your Skin

To care for your skin, both during and after radiation therapy:

- Gently wash skin with warm (not hot) water and a mild, unscented soap, rinse well, and pat dry.
- Ask your treatment team before using any skincare products on the treatment area.
- Do not scratch or pick at skin.
- Protect your skin from the sun.
- Do not expose your skin to extreme heat or cold, such as ice packs or heating pads.
- Wear loose clothes.
- Use a fragrance-free laundry detergent.

If your skin becomes itchy or dry, your treatment team may order a special moisturizer. Follow your treatment team's directions for caring for your skin.

Visit www.LLS.org/booklets to view *Side-Effect Management: Caring for Skin, Nails, Hair and Mouth.*

Questions to Ask Your Healthcare Team

- Is radiation therapy a good option for me? If so, what will be the goal of treatment?
- How often will I receive treatment?
- What are the potential side effects, including late effects?
- How can I manage side effects?
- How can I care for my skin during treatment?
- Can this treatment affect my ability to become pregnant or have a child? If Yes, should I speak with a fertility specialist before I begin radiation therapy?
- How will I be monitored for late effects?

Feedback. To make suggestions about the content of this booklet, visit www.LLS.org/PublicationFeedback.

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Resources and Information

LLS is the world's largest voluntary health organization dedicated to funding blood cancer research, education and patient services. LLS has regions throughout the United States and in Canada. To find the region nearest to you, visit our website at www.LLS.org/LocalPrograms or contact an Information Specialist at (800) 955-4572.

LLS offers free information and services for patients and families affected by blood cancers. This section lists various resources you may find helpful.

For Help and Information

Consult with an Information Specialist. Information Specialists can assist you through cancer treatment, financial and social challenges and give accurate, up-to-date disease, treatment and support information. Our Information Specialists are highly trained oncology social workers and nurses. Language services are available. For more information, please:

- Call: (800) 955-4572 (Monday through Friday, 9 a.m. to 9 p.m. ET)
- Email and Live chat: www.LLS.org/InformationSpecialists

Clinical Trials (Research Studies). Research is ongoing to develop new treatment options for patients. LLS offers help for patients and caregivers in understanding, identifying and accessing clinical trials. Pediatric and adult patients and caregivers can work with our Clinical Trial Nurse Navigators who will help find clinical trials and provide personalized support throughout the entire clinical trial process. Visit www.LLS.org/CTSC for more information.

Nutrition Consultations. Schedule a free one-on-one nutrition consultation with one of our registered dietitians who have expertise in oncology nutrition. Consultations are available to patients and caregivers of all cancer types. Dietitians can assist with information about healthy eating strategies, side effect management and more. Please visit www.LLS.org/nutrition for more information.

Free Information Booklets. LLS offers free education and support booklets for patients, caregivers and healthcare professionals that can either be read online or ordered. Please visit www.LLS.org/booklets for more information.

Telephone/Web Education Programs. LLS offers free telephone/Web and video education programs for patients, caregivers and healthcare professionals. Please visit www.LLS.org/programs for more information.

Financial Assistance. LLS offers financial support to eligible individuals with blood cancer for insurance premiums, co-pays, and non-medical expenses like travel, food, utilities, housing, etc. For more information, please:

- Call: (877) 557-2672
- Visit: www.LLS.org/finances

Podcast. *The Bloodline with LLS* is here to remind you that after a diagnosis comes hope. Listen in as patients, caregivers, advocates, doctors and other healthcare professionals discuss diagnosis, treatment options, quality-of-life concerns, treatment side effects, doctor-patient communication and other important survivorship topics. Visit www.LLS.org/TheBloodline for more information and to subscribe to access exclusive content, submit ideas and topics, and connect with other listeners.

Free Mobile Apps.

- LLS Coloring For Kids™ – Allows children (and adults) to express their creativity and offers activities to help them learn about blood cancer and its treatment. Visit www.LLS.org/ColoringApp to download for free.
- LLS Health Manager™ – Helps you track side effects, medication, food and hydration, questions for your doctor, and more. Visit www.LLS.org/HealthManager to download for free.

Suggested Reading. LLS provides a list of selected books recommended for patients, caregivers, children and teens. Visit www.LLS.org/SuggestedReading to find out more.

Connecting with Patients, Caregivers and Community Resources

LLS Community. The one-stop virtual meeting place for talking with other patients and receiving the latest blood cancer resources and information. Share your experiences with other patients and caregivers and get personalized support from trained LLS staff. Visit www.LLS.org/community to join.

Weekly Online Chats. Moderated online chats can provide support and help cancer patients and caregivers reach out and share information. Please visit www.LLS.org/chat for more information.

Local Programs. LLS offers community support and services in the United States and Canada including the *Patti Robinson Kaufmann First Connection® Program* (a peer-to-peer support program), local support groups and other great resources. For more information about these programs or to contact your region, please:

- Call: (800) 955-4572
- Visit: www.LLS.org/LocalPrograms

Advocacy and Public Policy. Working closely with dedicated volunteer advocates, LLS's Office of Public Policy elevates the voices of patients to state and federal elected officials, the White House, governors and even courts. Together, we advocate for safe and effective treatments. We pursue policies that would make care more accessible to all patients. And, most of all, we advocate for the hope for a cure. Want to join our work? Visit www.LLS.org/advocacy for more information.

Other Helpful Organizations. LLS offers an extensive list of resources for patients and families. There are resources that provide help with financial assistance, counseling, transportation, patient care and other needs. For more information, please visit www.LLS.org/ResourceDirectory to view the directory.

Additional Help for Specific Populations

Información en Español (LLS information in Spanish). Please visit www.LLS.org/espanol for more information.

Language Services. Let members of your healthcare team know if you need translation or interpreting services because English is not your native language, or if you need other assistance, such as a sign language interpreter. Often these services are free.

Information for Veterans. Veterans who were exposed to Agent Orange while serving in Vietnam may be able to get help from the United States Department of Veterans Affairs. For more information, please

- Call: the VA (800) 749-8387
- Visit: www.publichealth.va.gov/exposures/AgentOrange

Information for Firefighters. Firefighters are at an increased risk of developing cancer. There are steps that firefighters can take to reduce the risk. Please visit www.LLS.org/FireFighters for resources and information.

World Trade Center Health Program. People involved in the aftermath of the 9/11 attacks and subsequently diagnosed with a blood cancer may be able to get help from the World Trade Center (WTC) Health Program. People eligible for help include:

- Responders
- Workers and volunteers who helped with rescue, recovery and cleanup at the WTC-related sites in New York City (NYC)
- Survivors who were in the NYC disaster area and those who lived, worked or were in school in that area
- Responders to the Pentagon and the Shanksville, PA, crashes

For more information, please

- Call: WTC Health Program at (888) 982-4748
- Visit: www.cdc.gov/wtc/faq.html

People Suffering from Depression. Treating depression has benefits for cancer patients. Seek medical advice if your mood does not improve over time, for example, if you feel depressed every day for a two-week period. For more information, please:

- Call: The National Institute of Mental Health (NIMH) at (866) 615-6464
- Visit: NIMH at www.nimh.nih.gov and enter "depression" in the search box

Other Resources

American Society for Radiation Oncology
www.rtanswers.org

The American Society for Radiation Oncology (ASTRO) created this website to explain to patients, their families and the public how doctors called "radiation oncologists" use radiation therapy to treat cancer safely and effectively.

Cancer.Net
https://www.cancer.net/navigating-cancer-care/how-cancer-treated/radiation-therapy

The American Society of Clinical Oncology (ASCO)'s patient website provides timely, comprehensive information to help patients and families make informed health care decisions.

National Cancer Institute
https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy

The National Cancer Institute (NCI) website contains reliable, objective and evidence-based information on cancer and cancer treatment.

References

The Leukemia & Lymphoma Society (LLS) has many disease-specific booklets. Information from some of these was used to create this fact sheet. Visit www.LLS.org/booklets for more.

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