What is Radiation Therapy?

An explanation of the cancer treatment: how it works and how it's performed.

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Oncologists have many tools they use to treat cancer, and one of the most commonly used is radiation therapy. In use since the early 1900s, radiation therapy uses high-energy particles or waves — including x-rays, gamma rays, electron beams, and protons — to destroy or damage cancer cells. The machine that delivers radiation therapy has a head that rotates 360 degrees, and patients lie on a special bench that swivels, allowing the radiation to be delivered from any angle.

Unlike chemotherapy and other treatments taken by mouth or injection, radiation therapy typically is a local treatment aimed only at the part of the body that needs therapy. Radiation therapy is designed to damage cancer cells while causing as little harm as possible to nearby healthy cells.

"Much of the training of a radiation oncologist involves understanding the disease in the context of the patient and figuring out what the best dosing and delivery will be," says University of Colorado Cancer Center member Sana Karam, MD, PhD. "The side effects of radiation very much depend on the area being treated. It's all about geography. Which area is being targeted, and how much the surrounding normal tissue can take, will dictate side effects. They can range from simple tiredness to more severe side effects if we are hitting a major organ with high dose."

How it works

Classically, radiation is known to work by causing small breaks in the DNA inside cells. These breaks keep cancer cells from growing and dividing, which causes them to die. Normal cells near the targeted cells can be affected by radiation, but those cells almost always recover and go back to working the way they should. More recently, researchers have discovered that radiation has effects beyond the cancer cell and can act on different components within the area where the cancer cell lives — the so called tumor microenvironment. Radiation can also help signal the body that there an injury that needs to be repaired.

"We now know that radiation can act as a strong immune stimulant in combination with immunotherapy," says Karam, associate professor of radiation oncology in the CU School of Medicine.

The most common radiation treatment, external-beam radiation therapy (EBRT), uses a machine

located outside the body to focus a beam of x-rays on the area with the cancer.

Common types of EBRT include intensity-modulated radiation therapy (IMRT), stereotactic radiosurgery (SRS), and stereotactic body radiation therapy (SBRT).

IMRT: This type of radiation maximizes the radiation delivered to the planned target while minimizing the radiation to normal tissue by delivering smaller doses of radiation over longer lengths of time.

SRS: This type of radiation gives larger doses of radiation in shorter periods of time, which helps to preserve healthy tissue. SRS is used to treat functional abnormalities and small tumors of the brain; when SRS is used to treat body tumors, it's called stereotactic body radiotherapy (SBRT).

Brachytherapy, or internal radiation therapy, involves the insertion of radioactive seeds, ribbons, or capsules in the body, in or near the tumor. Brachytherapy is often used to treat cancers of the breast, cervix, head and neck, prostate, and eye.

Systemic radiation therapy is a treatment that travels through your entire body instead of being aimed at one area. Liquid drugs are taken orally or put into a vein, then they move through the body, concentrating in areas where cancer cells are located. Systemic radiation therapy is most often used to treat thyroid, bone, and prostate cancer.

How it's performed

Radiation treatment involves numerous people, including physicists, dosimetrists, medical assistants, radiation therapists, and nurses. These people are trained to be very specific components of the setup, planning, and treatment process.

The medical professionals involved in providing radiation therapy include:

- Radiation oncologist: A doctor specially trained to use radiation to treat cancer. A radiation oncologist oversees a patient's radiation treatment plan.
- Radiation physicist: Assures the radiation equipment is working properly and delivers the exact dose prescribed by the dosimetrist and radiation oncologist.
- Dosimetrist: A radiation therapist who has received special training to calculate the correct dose of radiation and how often it should be delivered.
- Radiation therapist or radiation therapy technologist: Operates the radiation therapy equipment and positions patients for planning and treatment.
- Radiation therapy nurse: A nurse with special training in cancer treatment who can give

patients information about radiation treatment and possible side effects.

The radiation therapy care path

Radiation oncology is a part of the oncology multi-disciplinary team. When radiation oncologists first meet with a patient, they perform a physical exam, get a medical history, review any imaging that has been done around the cancer, and confirm the staging. Staging refers to how far the cancer has progressed and if it has spread to other areas in the body. The patient's personal history, social situation, goals of care, and discussion with different team members are important to help the radiation oncologist determine what type and duration of radiation treatment will be most effective.

"Understanding the patterns of spread of the cancer, and understanding how the radiation will affect the patient, are critical to designing a good radiation plan," Karam says. "It's very easy to miss an area where the cancer might be, just as it is also easy to overtreat and cause lifelong toxicity."

The next step in the process is called simulation. The radiation therapy team places the patient in the optimal position for the radiation to reach the affected areas, then marks are made on the skin, and imaging scans are done to help the oncologist finalize the plan.

The radiation oncologist works with the dosimetrist and medical physicist to ensure the dosage is correct, then the patient begins treatment. Radiation treatments are usually scheduled daily, Monday through Friday, for a period of one to nine weeks. Appointments typically last around 15 minutes, though the actual radiation is only given for 2-3 minutes. Treatment has improved in recent years so that a treatment plan that used to take nine weeks often takes only one or two.

The radiation oncologist monitors the patient throughout the treatment cycle, doing imaging to make sure the therapy is working as it should and interviewing and examining the patient for signs of toxicity and to assess the tumor progress. Patients often may not feel anything during the treatment and, depending what area is being treated, often patients are able to drive themselves to and from the radiation therapy sessions.

After patients complete radiation therapy, short- and long-term follow up is a critical aspect of what radiation oncologists do. Sometimes side effects may not emerge until later, so follow up is an important aspect of the care path. The radiation oncologist may ask for additional imaging to see if the radiation was successful in treating the cancer. The oncologist will assess the patient's progress and offer additional guidance.

"It takes a village to care for the radiation oncology patient, and each member of the team is essential to orchestrate the care," Karam says. "This is true whether working within the radiation oncology team or with the interdisciplinary team. We all have a core interest of doing what's best for the patient."