Radiation therapy or radiotherapy, is a therapy using ionizing radiation, generally as part of cancer treatment to control or kill malignant cells and normally delivered by a linear accelerator.

Radiation therapy may be curative in a number of types of cancer if they are localized to one area of the body.

It may also be used as part of adjuvant therapy, to prevent tumor recurrence after surgery to remove a primary malignant tumor (for example, early stages of breast cancer).

Radiation therapy is synergistic with chemotherapy and has been used before, during, and after chemotherapy in susceptible cancers.

The subspecialty of oncology concerned with radiotherapy is called radiation oncology.

Radiation therapy is commonly applied to the cancerous tumor because of its ability to control cell growth.

Ionizing radiation works by damaging the DNA of cancerous tissue leading to cellular death.

To spare normal tissues (such as skin or organs which radiation must pass through to treat the tumor), shaped radiation beams are aimed from several angles of exposure to intersect at the tumor, providing a much larger absorbed dose there

than in the surrounding, healthy tissue.

Besides a tumor itself, the radiation fields may also include the draining lymph nodes if they are clinically or radiologically involved with tumor, or if there is thought to be a risk of subclinical malignant spread.

Radiation oncology is the medical specialty concerned with prescribing radiation and is distinct from radiology, the use of radiation in medical imaging and diagnosis.

Radiation may be prescribed by a radiation oncologist with intent to cure ("curative") or for adjuvant therapy.

It may also be used as palliative treatment (where the cure is not possible and the aim is for local disease control or symptomatic relief) or as therapeutic treatment (where the therapy has a survival benefit and it can be curative).

It is also common to combine radiation therapy with surgery, chemotherapy, hormone therapy, immunotherapy or some mixture of the four.

Most common cancer types can be treated with radiation therapy in some way.

The precise treatment intent (curative, adjuvant, neoadjuvant therapeutic, or palliative) will depend on the tumor type, location, and

stage, as well as the general health of the patient.

Total body irradiation (TBI) is a radiation therapy technique used to prepare the body to receive a bone marrow transplant.

Brachytherapy, in which a radioactive source is placed inside or next to the area requiring treatment, is another form of radiation therapy that minimizes exposure to healthy tissue during procedures to treat cancers of the breast, prostate and other organs.

Different cancers respond to radiation therapy in different ways.

The response of cancer to radiation is described by its radiosensitivity.

Highly radiosensitive cancer cells are rapidly killed by modest doses of radiation. These include leukemias, most lymphomas, and germ cell tumors.

The majority of epithelial cancers are only moderately radiosensitive and require a significantly higher dose of radiation to achieve a radical cure.

Some types of cancer are notably radioresistant, that is, much higher doses are required to produce a radical cure that may be safe in clinical practice.

Leukemias are not generally curable with radiation therapy, because they are disseminated through the body.

Lymphoma may be radically curable if it is localized to one area of the body.

Similarly, many of the common, moderately radioresponsive tumors are routinely treated with curative doses of radiation therapy if they are at an early stage.

Metastatic cancers are generally incurable with radiation therapy because it is not possible to treat the whole body.

Before treatment, a CT scan is often performed to identify the tumor and surrounding normal structures.

The patient receives small skin marks to guide the placement of treatment fields.

Patient positioning is crucial at this stage as the patient will have to be set-up in the identical position during treatment.

The response of a tumor to radiation therapy is also related to its size.

Due to complex radiobiology, very large tumors respond less well to radiation than smaller tumors or microscopic disease.

The most common technique is surgical resection prior to radiation therapy.

Another method is to shrink the tumor with neoadjuvant chemotherapy prior to radical radiation therapy.

A third technique is to enhance the radiosensitivity of the cancer by giving certain drugs during a course of radiation therapy.

Side effects

Radiation therapy is in itself painless.

Many low-dose palliative treatments (for example, radiation therapy to bony metastases) cause minimal or no side effects, although short-term pain flare-up can be experienced in the days following treatment due to edema compressing nerves in the treated area.

Higher doses can cause varying side effects during treatment (acute side effects), in the months or years following treatment (long-term side

effects), or after re-treatment (cumulative side effects).

The nature, severity, and longevity of side effects depend on the organs that receive the radiation, the treatment itself, the type of radiation, dose, fractionation, concurrent chemotherapy), and the patient.

Most side effects are predictable and expected.

Side effects from radiation are usually limited to the area of the patient's body that is under treatment.

Side effects are dose-dependent.

The main side effects reported are fatigue and skin irritation, like a mild to moderate sunburn. The fatigue

often sets in during the middle of a course of treatment and can last for weeks after treatment ends.

The irritated skin will heal, but may not be as elastic as it was before.

Acute side effects

Nausea and vomiting

This is not a general side effect of radiation therapy and is associated only with treatment of the stomach or abdomen (which commonly react a few hours after treatment), or with radiation therapy to certain nausea-producing structures in the head during treatment of certain head and neck tumors, most commonly the vestibules of the inner ears.

Damage to the epithelial surfaces

Epithelial surfaces may sustain damage from radiation therapy.

When treating liver malignancies and metastases, it is possible for collateral radiation to cause gastric, stomach or duodenal ulcers.

Intestinal discomfort

The lower bowel may be treated directly with radiation (treatment of rectal or anal cancer) or be exposed by radiation therapy to other pelvic structures (prostate, bladder, female genital tract). Typical symptoms are soreness, diarrhea, and nausea.

Swelling

As part of the general inflammation that occurs, swelling of soft tissues may cause problems during radiation therapy.

Infertility

The gonads (ovaries and testicles) are very sensitive to radiation.

Late side effects

Late side effects occur months to years after treatment and are generally limited to the area that has been treated.

Fibrosis

Tissues which have been irradited tend to become less elastic over time due to a diffuse scarring process.

Epilation

Epilation (hair loss) may occur on any hair-bearing skin.

Dryness

The salivary glands and tear glands have a radiation tolerance.

Lymphedema

Lymphedema, a condition of localized fluid retention and tissue swelling, can result from damage to the lymphatic system sustained during radiation therapy.

Cancer

Radiation is a potential cause of cancer, and secondary malignancies are seen in a very small minority of patients.

Cardiovascular late side effects have been termed radiation-induced heart disease (RIHD) and radiation-induced vascular disease (RIVD).

Symptoms are dose-dependent and include cardiomyopathy, myocardial fibrosis, valvular heart disease, coronary artery disease, heart arrhythmia and peripheral artery disease.

Radiation enteropathy

The gastrointestinal tract can be damaged following abdominal and pelvic radiotherapy.

Radiation therapy accidents

There are rigorous procedures in place to minimize the risk of accidental overexposure of radiation therapy to patients.

ASTRO has launched a safety initiative called Target Safely that, among other things, aims to record errors nationwide so that doctors can learn from each and every mistake and prevent them from happening.

ASTRO also publishes a list of questions for patients to ask their doctors about radiation safety to ensure every treatment is as safe as possible.

Dose

Different cancer types have different radiation sensitivity.

Types

Historically, the three main divisions of radiation therapy are :

1. External beam radiation therapy (EBRT or XRT) or teletherapy

2. Brachytherapy or sealed source radiation therapy

3. Systemic radioisotope therapy or unsealed source radiotherapy.

Medicine has used radiation therapy as a treatment for cancer for more than 100 years.

CT-based planning allows physicians to more accurately determine the dose distribution using axial tomographic images of the patient's anatomy.

The advent of new imaging technologies, including magnetic resonance imaging (MRI) and positron emission tomography (PET), has moved radiation therapy from 3-D conformal to intensity-modulated radiation therapy (IMRT) and to image-guided radiation therapy (IGRT) tomotherapy.

These advances allowed radiation oncologists to better see and target tumors, which have resulted in better treatment outcomes, more organ preservation, and fewer side effects.