

# USING RADIATION IN CANCER TREATMENT

There are two major uses of ionizing radiation in the diagnosis and treatment of cancer:

HIGH  
LOW



**Radiology** largely uses low-energy radiation to image tissues to diagnose disease, e.g., Gallium 68 PSMA-11 (Ga 68 PSMA-11) and piflufolastat F 18 (Pylarify) radiopharmaceuticals that have been recently approved by FDA to detect metastatic prostate cancer lesions.

HIGH  
LOW



**Radiotherapy**, or radiation therapy, uses high-energy radiation to control and eradicate cancer.

## Radiotherapy

- Radiotherapy is the use of high-energy rays (e.g., gamma rays and X-rays) or particles (e.g., electrons, protons, and carbon nuclei) to control or eliminate cancer.
- Radiotherapy works primarily by damaging DNA, leading to cancer cell death with relative sparing of normal tissues, a feat achieved by using sophisticated approaches, such as computer analytic programs that optimize the delivery of the radiation to the tumor while minimizing exposure of normal tissues.



## Uses of Radiotherapy

**Curative radiotherapy** seeks to eliminate cancers, particularly small and locally advanced cancers; it is often used in combination with systemic therapy.

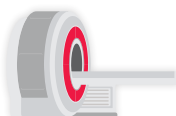
**Neoadjuvant radiotherapy** is used to shrink a tumor so that it can be subsequently treated by a different method such as surgery.

**Adjuvant radiotherapy** seeks to eliminate any remaining cancer following prior treatment.

**Palliative radiotherapy** is used to reduce or control symptoms of disease when cure by another method is not possible.

## Types of Radiotherapy

**External beam radiotherapy**, usually photons (X-rays) or electrons, delivers radiation to the tumor from outside the body; it is the most common form of radiotherapy.



- Conventional (2-D) external beam radiation therapy delivers a high-energy X-ray beam from one or more directions. Imaging of the treatment area is typically performed using low-energy diagnostic X-rays. It is primarily used in settings where high precision is not required, such as in the treatment of bone metastases.
- 3-D conformational radiotherapy (3DCRT) uses specialized imaging, usually computed tomography (CT) and/or magnetic resonance imaging (MRI) and planning software to deliver high-energy X-rays via multiple beams that more precisely target the shape and size of the tumor.
- Intensity-modulated radiotherapy (IMRT) is a refinement of 3DCRT that more precisely focuses and shapes the radiation by dividing each beam into many "beamlets," each of which can have a different intensity.
- Intraoperative radiation therapy uses electron beam (superficial) radiation directly on tumors that have been exposed during surgical procedures.
- Stereotactic radiotherapy is used in both stereotactic surgery (SRS) and stereotactic body radiotherapy

(SBRT). It uses typically more than eight beams with a highly sophisticated imaging system to direct radiation to very well-defined smaller tumors. Usually, SRS is used to treat tumors of the brain and central nervous system, whereas SBRT can be used on small tumors within larger organs of the body.

**Particle therapy** refers to protons or carbon ions rather than X-rays as the source of energy. In contrast to X-rays that cause damage to the noncancerous tissues through which they pass, these heavier particles deposit most of their energy in the target. In this manner, particle therapy can deliver higher doses with less damage to surrounding tissue. Although of great interest, proton facilities are much more expensive than traditional facilities, and the overall benefit to selected patients is still being determined.



**Brachytherapy** places small radioactive sources in or next to the tumor either temporarily or permanently.



**Radioisotope therapy** involves systemic ingestion or infusion of radioisotopes, for example, iodine-131 to treat thyroid cancer or lutetium Lu 177 dotatate (Lutathera) to treat gastroenteropancreatic neuroendocrine tumors.