Radiation Therapy

University of Rhode Island – BME 181

Gemma Downey

Radiation Therapy also called radiation oncology is the use of ionizing radiation as part of cancer treatment to control harmful or malignant cells. Do not confuse with radiology (use of radiation in medical imaging).

Radiation Therapy may be used for **adjuvant** cancer treatment (defined as auxiliary, or supplemental treatment following cancer surgery). Adjuvant therapy is treatment given after surgery where all detectable disease has been removed, but where the patient could relapse

It is used as **palliative treatment**, when you can't cure the disease, but you could still offer some relief or to control the disease.

How It Works: Radiation is energy that travels in waves (electromagnetic radiation) or high-speed particles.

Ionizing Radiation is so high in energy it can break chemical bonds. At this high energy, it can destroy the nucleus of a cell. So when ionizing radiation passes through tissues of the body, it has enough energy to damage DNA.

Radiation therapy damages the DNA of cells. This damage is caused by a beam ionizing the atoms which forms free radicals that then damage the DNA. Cancer cells reproduce more and can't repair sub-lethal damage compared to most healthy cells. The damage goes with cell division causing cancer cells to die or reproduce more slowly.

However, one thing can inhibit the radiotherapy treatment: It's a low-oxygen state of a solid tumor called **hypoxia**. If a solid tumor outgrows its blood supply, its 2 to 3 times more resistant to radiation therapy. To fix this, scientists are researching blood substitutes that carry oxygen.

Dosages: Radiation Oncologists decide the dose: Dosages are measured in the unit **gray**. The oncologists adjust the amount given by considering the type and location of the cancer, whether the patient is receiving chemotherapy, or whether radiation therapy is given before or after surgery. Dosages are split up (fractionized) over time so normal cells can recover and tumor cells are less efficient between fractions.

Radioresistance: Different Cancers respond differently to radiation therapy. Highly radiosensitive cancer cells are killed by modest doses of radiation.

Effectiveness on Differing Cancers

Leukemia has a high radiosensitivity and therefore only needs a low dose of radiation, however, they are generally disseminated through the body. Lymphoma may be more curable if in one area in the body. Some moderately radiosensitive cancers are pretty curable if they are in the early stages. Metastatic (cancer that spreads through the whole body) is incurable because you cannot treat the whole body.

Alternatives: Large tumors respond less well than smaller tumors. So other options include surgery before radiotherapy, shrink the tumor with chemotherapy, or make the tumor more radiosensitive with drugs.

Types:

1. **External Beam Radiotherapy (EBRT)** – patient lies down and an external source of radiation is pointed at the body. Kilovoltage x-rays treat superficial structures (skin cancer). Megavoltage x-rays treat deep set tumors (bladder, lung, brain, etc)
2. **Brachytherapy** – (also known as internal radiotherapy or sealed source radiotherapy) the radiation source is placed inside the area requiring treatment (used for cervical, prostate, breast cancers, etc). As opposed to EBRT, this therapy has precise placement at the site of the tumor. The radiation only affects that area, exposure to nearby tissues is reduced, and if the patient moves, the radiation sources stay in place
3. **Unsealed Source radiotherapy** – (intense) radioactive substances (like iodince-131) is injected into the body. It will go to the thyroid gland, destroy the thyroid tissue and any thyroid cancer too. This is dangerous because the patient becomes radioactive. The iodine is excreted through urine and the patient will need time before they aren't dangerous to bystanders. There are strict radiation regulations regarding this issue.

Side effects include fatigue, skin irritation (like a sunburn), reduced skin elasticity.

References:

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