New Radiation Tools and Techniques for Cancer Treatment

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CDC & Florida DOH Attribution

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  - Systemic Radiation Therapy - Radioisotopes
- Dose, Volume, Number of Treatments (Fractionation & Total Dose)
- Radiation Therapy Delivery – Modality
- Case Studies for Coding Radiation Treatment
- Questions

Introduction

- Radiation therapy uses high-energy particles or waves, such as x-rays, gamma rays, electron beams, or protons, to destroy or damage cancer cells.

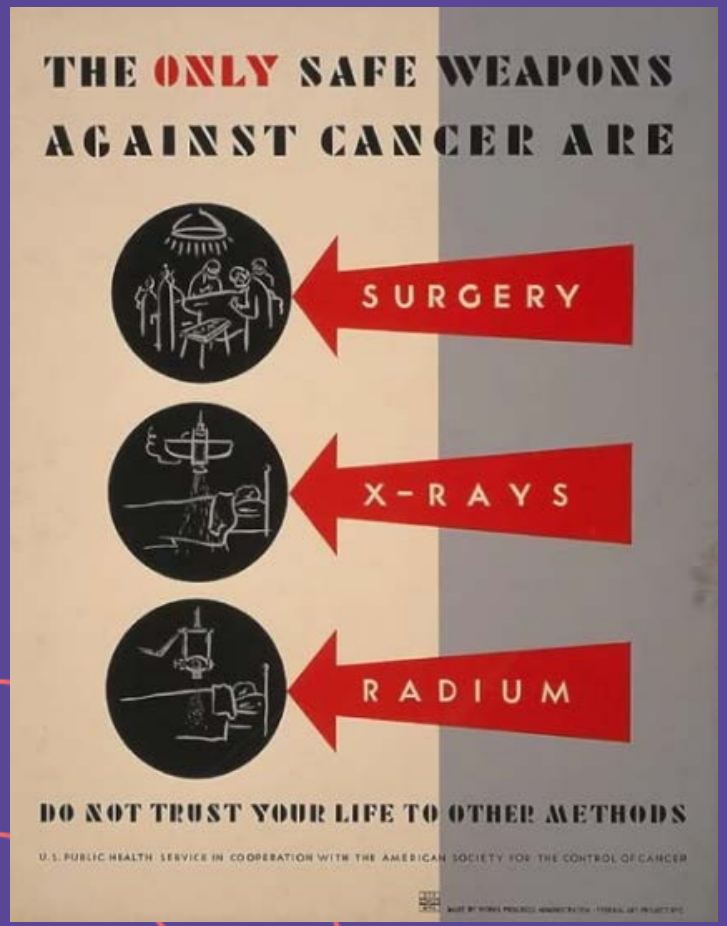
- Your cells normally grow and divide to form new cells. But cancer cells grow and divide faster than most normal cells. Radiation works by making small breaks in the DNA inside cells. These breaks keep cancer cells from growing and dividing and cause them to die. Nearby normal cells can also be affected by radiation, but most recover and go back to working the way they should.

- Unlike chemotherapy, which usually exposes the whole body to cancer-fighting drugs, radiation therapy is usually a local treatment. In most cases, it's aimed at and affects only the part of the body being treated. Radiation treatment is planned to damage cancer cells, with as little harm as possible to nearby healthy cells.

- Some radiation treatments (systemic radiation therapy) use radioactive substances that are given in a vein or by mouth. Even though this type of radiation does travel throughout the body, the radioactive substance mostly collects in the area of the tumor, so there's little effect on the rest of the body.

https://www.cancer.org/treatments/radiation/basics.html

Brief History of Radiation Therapy



1895 – X-rays discovered - Roentgen
1898 – X-rays used to treat breast cancer
1898 – Radium rays discovered – Curie's
1901 – Roentgen won Nobel Prize in Physics
1910 – High energy x-rays treating deep cancers
1920 – Radioactive isotopes, new rays, new techniques
1920 – Fractionated Dose instead of Single Dose
1930-1950 – Orthovoltage Era & interstitial radiation
1950-1980 – Megavoltage Era – Cobalt therapy, linear accelerators
1970-1980 – Proton Beam devices
1990 – 3D Conformal/Stereotactic radiation therapy devices
2000 – Adaptive radiation therapy – image guided therapies

Global Dermatology https://doi.org/10.3889/oamjms.2017.122

Brief History of Radiation Therapy

Table 2

Different modalities of radiotherapy available for the treatment of dermatological diseases

TREATMENT	TYPE OF RADIATION	CLINICAL INDICATIONS
Low energy superficial kilovoltage	X-ray	Localised superficial skin cancers
Orthovoltage X-ray	X-rays	Localised superficial skin cancers
High energy megavoltage (MV) photons	X-rays	Rarely used. Skin cancer with deep penetration
Electron Beam Therapy (Linac)	Electrons	Large or thick lesions
Cobalt therapy	Gamma-rays	Like Linac, by which they are often replaced
Brachytherapy	Radioactive sources (e.g. Au, CO, Celsium, Iridium…) localised into tumour tissues (variable energy)	Tumours localised in critical sites

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Radiation Therapy Delivery - Techniques

- External Beam Radiation Therapy
- Internal Radiation Therapy or Brachytherapy
- Systemic Radiation Therapy or Total Body Radiation Therapy
- Types of Radiation Therapy Devices
- Radiation Dose, Volume, Number of Treatments, and Fractionation

Radiation Therapy Delivery – CoC Techniques

- External Beam, NOS
- Low Energy X-Ray/Photon Therapy
- 2-D Therapy
- 3-D Conformal Therapy
- Intensity Modulated Therapy
- Stereotactic Radiotherapy/Radiosurgery - NOS
- Stereotactic Radiotherapy/Radiosurgery – Robotic
- Stereotactic Radiotherapy/Radiosurgery – Gamma Knife
- CT-Guided Online Adaptive Therapy
- MR-Guided Online Adaptive Therapy

External Beam Radiation Therapy

- Conventional external beam radiation therapy (2DXRT)
- Three-dimensional conformal radiation therapy (3D-CRT)
- Image guided radiation therapy (IGRT)
- Intensity modulated radiation therapy (IMRT)
- Helical-tomotherapy
- Photon beam radiation therapy
- Proton beam radiation therapy
- Stereotactic radiosurgery
- Intraoperative radiation therapy (IORT)
- Stereotactic body radiation therapy (SBRT)
- Volumetric modulated arc therapy (VMAT)
- High Definition Radiotherapy (HDRT) & High Definition Radiosurgery (HDRS)

https://www.cancer.org/treatments/radiation/basics.html

Internal Radiation Therapy - Brachytherapy

- Internal radiation therapy (brachytherapy) allows a higher dose of radiation in a smaller area than might be possible with external radiation treatment.
- It uses a radiation source that's usually sealed in a small holder called an implant. Different types of implants may be called pellets, seeds, ribbons, wires, needles, capsules, balloons, or tubes.
- No matter which type of implant is used, it is placed in your body, very close to or inside the tumor. This way the radiation harms as few normal cells as possible.
- During intracavitary radiation, the radioactive source is placed in a body cavity (space) , such as the rectum or uterus.
- With interstitial radiation, the implants are placed in or near the tumor, but not in a body cavity.

https://www.cancer.org/treatments/radiation/basics.html

High Dose or Low Dose Brachytherapy?

- High-dose-rate (HDR) brachytherapy allows a person to be treated for only a few minutes at a time with a powerful radioactive source that's put in the applicator.
- The source is removed after several minutes. This may be repeated over the course of a few days to weeks. The radioactive material is not left in your body. The applicator might be left in place between treatments, or it might be put in before each treatment.
- Low-dose-rate (LDR) brachytherapy allows the implant to give off lower doses of radiation over a longer period.
- Some implants are left in from 1 to a few days and then removed. You'll probably have to stay in the hospital, sometimes in a special room, during treatment. For larger implants, you might have to stay in bed and lie still to keep it from moving.
- Some smaller implants (such as the seeds or pellets) are left in place – they're never taken out. Over the course of several weeks they stop giving off radiation. The seeds are about the size of rice grains and rarely cause problems. If your implants are to be left in, you may be able to go home the same day they're put in.

https://www.cancer.org/treatments/radiation/basics.html

Systemic Radiation Therapy - Radioisotopes

- Certain cancers, such as thyroid, bone, and prostate are treated with radiopharmaceuticals (radioactive drugs) . A radiopharmaceutical is a liquid drug made up of a radioactive substance. It is sometimes bound to a special antibody (called a monoclonal antibody) that attaches to the cancer cells. Examples of radiopharmaceuticals used for systemic radiation include radioactive iodine, strontium, samarium, and radium.

- These drugs may be given in a vein (IV) or taken by mouth. They travel in the blood throughout the body. The antibody makes them attach to the cancer cells. They then give off their radiation and kill the cancer cells.

- Radioisotopes – I-131, Strontium-90, Strontium-89, Radium-223

- Radioimmunotherapy

https://www.cancer.org/treatments/radiation/basics.html

Types of Radiation Therapy Devices

- Most are referred to by who makes the machine/device
  - Varian
  - Siemans
  - Elekta
  - Accuray
  - C.R. Bard
  - IBA Worldwide
- CT Simulators for Treatment Planning
- Linear Accelerator or ‘linac’ for External Beam Radiation
- Stereotactic Delivery - Gamma Knife, X-Knife, CyberKnife, Clinac
- Implants (Brachytherapy)
  - Radioactive seeds - implants
  - MammoSite – catheter
  - Savi Breast Brachytherapy - catheter
  - High Dose Remote Afterloader – catheter
  - TheraSphere – radio embolization – glass beads via catheter

Radiation Therapy Delivery – Modality

Code	Label
00	No radiation treatment
01	External beam, NOS
02	External beam, photons
03	External beam, protons
04	External beam, electrons
05	External beam, neutrons
06	External beam, carbon ions
07	Brachytherapy, NOS
08	Brachytherapy, intracavitary, LDR
09	Brachytherapy, intracavitary, HDR
10	Brachytherapy, Interstitial, LDR
11	Brachytherapy, Interstitial, HDR
12	Brachytherapy, electronic
13	Radioisotopes, NOS
14	Radioisotopes, Radium-223
15	Radioisotopes, Strontium-89
16	Radioisotopes, Strontium-90
99	Radiation treatment modality unknown; Unknown if radiation treatment administered

Case Studies for Coding Radiation Therapy

CTR Guide to Coding Radiation Therapy Treatment in the STORE

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Radiation Oncology Working Group

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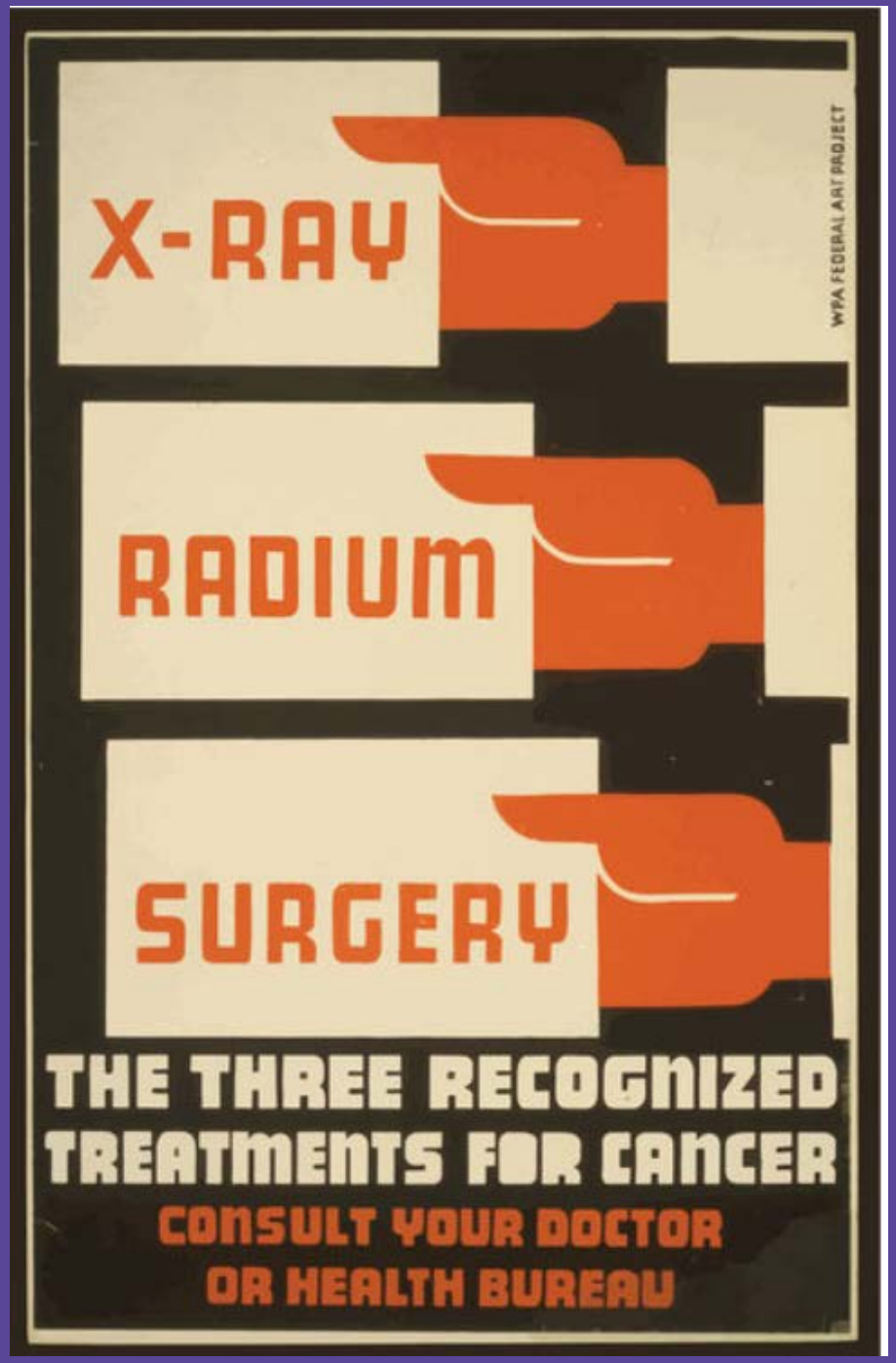
Resources

- American Cancer Society
- ASTRO – American Society for Radiation Oncology
- NCI – National Cancer Institute – About Cancer – Radiation Therapy
- NCI SEER – Surveillance, Epidemiology and End Results Program
- Commission on Cancer/American College of Surgeons
- CoC STORE Manual and Case Studies Coding Radiation Treatment
- Varian Medical Systems – Future of Radiation Therapy, Jan 2016
- Elekta – Motion Enable in Radiation – Volumetric Arc Therapy (VMAT)
- An Overview on Radiotherapy: From Its History to Its Current Applications in Dermatology, Global Dermatology/oamjms.2017.122

Questions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