Radiation Therapy for Sarcoma

Behrooz Hakimian, M.D.

Associate Professor Department of Radiation Oncology

Cedars Sinai Medical Center
What is radiation?

How does radiation work?

Why use radiation in sarcoma?

What is the process of radiation treatment?

What are the radiation modalities?

What are the Machines used?
Radiation is a form of energy

there's a spectrum of radiation from radio waves to high energy gamma Rays
How Does Radiation Work?

Radiation Damages the DNA of growing cells

If damage is severe, the cells are doomed to die

If the damage is repaired, no harm is done and cell continues to divide

cancer cells are not able to repair themselves well compared to the normal cells and preferentially die

therefore we can take advantage of the difference and control the cancer

Radiation therapy is localized treatment and generally does not affect the rest of the body
Goals of Radiation Therapy

Curative treatment

provide local control of tumors

for sarcomas combined with surgery

treatment can take several weeks

Palliative treatment

provide symptoms relief

shrink tumor affecting quality of life
Why Use Radiation for Sarcoma?

Surgery would be good to eradicate the trunk of a tree; however, the roots will eventually grow and result in growth of a new tree.

Radiation therapy can help to eradicate the roots that surgery cannot remove.

Radiation therapy is used in combination with surgery to control the primary tumor in the limbs and prevent amputation.

Also, radiation therapy can be used to control some of the metastatic sites.
Radiation Oncology Workflow

Consultation
- Referred from another physician
- Tissue diagnosis obtained
- Discuss goals of treatment and potential side effect

Simulation
- Typically done with CT scanner
- May be done clinically

Treatment
- Daily (Mon – Fri)
- Ranges between 1-35 days

Follow-up
- Short- & Long-term
Simulation

• Set up patient in treatment position
• Make any special equipment used for patient setup reproducibility
  ○ Mask
  ○ Alpha cradle (“bean bag”)
  ○ Breast Board
PLanning
Safety and Quality Assurance

Each radiation therapy treatment plan goes through many safety checks

The medical physicist checks the calibration of the linear accelerator on a regular basis to assure the correct dose is being delivered

The radiation oncologist, along with the dosimetrist and medical physicist go through a rigorous multi-step QA process to be sure the plan can be safely delivered

QA checks are done by the radiation therapist daily to ensure that each patient is receiving the treatment that was prescribed for them
Delivery of Radiation Therapy (RT)

External beam RT is delivered to patient by a *linear accelerator*

Unit of radiation: Gray (Gy)

Second most common type of radiation is *brachytherapy* (internal radiation)
Goal of Modern RT

- High Efficacy
- Low Efficacy
- High Toxicity
- Low Toxicity

“Old times”

“Modern Era”
Methods of Radiation Delivery

Two-dimensional radiation therapy (2D)

Three-dimensional conformal radiation therapy (3-D CRT)

Intensity modulated radiation therapy (IMRT)

Stereotactic Radiotherapy (SRS/SBRT)

Intraoperative Radiation Therapy (IORT)

Brachytherapy (intracavity, interstitial)

Particle Beam Therapy
Two Dimensional RT (2D)

Fig. 4A
3D-CRT

- Utilizes 3D imaging in treatment planning (i.e. CT, MRI, PET)
- Allows radiation oncologist to target a structure and avoid nearby normal tissues
- Routine clinical use pioneered by our own Benedick Fraas, PhD
Modern day computing and therapy hardware allows us to accurately exclude critical normal tissues.
Stereotactic body Radiotherapy (SBRT) aka SABR
Intensity-Modulated RT

Allows highly conformal doses to tumor while avoiding normal tissues

Technically very complex

Newer technique than 3D-CRT

More expensive
Stereotactic Radiotherapy

- High doses in very few fractions (1-5 total)
- Similar to IMRT but requires imaging at treatment time
- Can be used to replace surgery in selected patients
Image Guidance
Intraoperative Radiotherapy (IORT)

• Radiation delivered in the operating room at the time of surgery
• Single treatment (one fraction)
• Limited indications including some early stage breast cancers
Proton Therapy

- Favorable physical characteristics compared to conventional photon therapy
- Very expensive
  - $20M+ for single treatment room
  - $100M+ for multi-room system
- Lack of clinical data to support broad use
Brachtherapy
Machines Used in Radiation Oncology

Linear accelerators (LINAC)

- TrueBeam
- Versa
- Trilogy
- Synergy
- Precise
- Cyberknife

Proton Beam (sharp shooting radiation)

Gamma Knife (strictly used for treatment of brain)