Recognizing Acute and Late Side Effects of Radiation Treatment

Daniel Golden, MD
Chief Resident
Department of Radiation Oncology
University of Chicago Medical Center
Disclosures/Conflicts of Interest

• None

• About me:
  • Grew up in Oakland, California
  • Went to medical school at the University of Illinois
  • Currently radiation oncology chief resident at the University of Chicago (5 years of training)

• Still a 49ERS and A's fan
Goals

• Review how radiation complements surgery and chemotherapy

• What is radiation?

• Understand how radiation therapy works

• Review common acute (early) and late (months to years) side effects of radiation therapy
The Brain is Unique

- **SURGERY** - difficult to operate on many parts of the brain

- **CHEMOTHERAPY** – blood-brain barrier can prevent chemotherapy from reaching the tumor

- **RADIATION** - dose is limited by “critical structures”
  - Brainstem, optic nerves, inner ear, pituitary, etc

- Therefore, treatment of brain tumors frequently combines surgery, chemotherapy, and radiation
Treatment combination: Radiation closes the gap

- Surgery
- Chemotherapy
- Radiation
Goals

• Review how radiation complements surgery and chemotherapy

• What is radiation?

• Understand how radiation therapy works

• Review common acute (early) and late (months to years) side effects of radiation therapy
What is “radiation”

- Radiation is made up of “photons,” or packets of energy
- All electromagnetic waves are types of radiation
- Every photon has its own energy level
- Radiation used to treat cancer has more energy stored in each photon
What is “radiation”

- A radiation beam is made up of billions of photons, or individual energy packets.

- When the radiation (photon) beam strikes tissue, the photons begin to release their energy damaging DNA.

- As the beam moves deeper, there are fewer photons remaining to release energy.

- We know exactly how strong the beams are that are used for treatment, and we can calculate precisely how much radiation energy is being released into the tissue at any point.
Goals

- Review how radiation complements surgery and chemotherapy
- What is radiation?
- **Understand how radiation therapy works**
- Review common acute (early) and late (months to years) side effects of radiation therapy
Methods to deliver radiation

- **Linear accelerator** – workhorse of modern radiation oncology

- **CyberKnife®** - automobile factory robotic arm with a linear accelerator mounted on the end

- **Tomotherapy®** – modeled off of a CT scanner

- **Gamma Knife®** – specifically designed to treat brain tumors

- **Brachytherapy** – place the radiation source next to or into tumor
  - Low dose rate
  - High dose rate
Where do we get X-ray radiation from?
Linear Accelerator
Radiation treatment planning: Maximize tumor dose, minimize toxicity
Radiation treatment planning: Maximize tumor dose, minimize toxicity
Radiation treatment planning
Radiation treatment planning: Maximize tumor dose, minimize toxicity

• Treatment delivery methods:

  • Conventional radiation

  • 3D-conformal radiation
    • Computerized planning

  • IMRT (intensity modulated radiation therapy)
    • Computer determines optimal beams
    • Increased radiation dose, decreased side effects

  • IGRT (image guided radiation therapy)
3D-CRT

IMRT
Why Image Guided RT?

- Conventional RT
- 3D-CRT (3D-conformal)
- IMRT (Intensity modulated)
- IGRT (Image guided)
Goals

• Review how radiation complements surgery and chemotherapy

• What is radiation?

• Understand how radiation therapy works

• Review common acute (early) and late (months to years) side effects of radiation therapy
Why are there side effects?

• Normal tissue is better at healing than tumor, but there is still damage

• The art of radiation oncology is balancing the probability of controlling the tumor (we want this high) with the probability of causing a side effect (we want this low)

• Radiation oncologists are willing to accept some mild side effects to increase the chance of controlling the tumor (similar to surgeons)

• We will not accept a high risk of severe side effects and/or death to control a tumor
Acute (early) side effects

• During treatment → first 1-2 months after treatment
  • Headache
  • Nausea/vomiting
  • Skin irritation
  • Hair loss
  • Sore throat, dry mouth
  • Fatigue
Late side effects

- Months to years after treatment
  - Severe, extremely rare
    - Brainstem damage
    - Blindness (retina damage)
    - Second malignancy (solid tumors: sarcoma, gliomas, meningioma)
  - Severe, rare
    - Radionecrosis (tissue death caused by radiation)
    - Stroke
Late side effects

• Months to years after treatment
  • Less severe, more common
    • Mild cognitive impairment
    • Endocrine abnormalities (hypothalamus and pituitary damage)
  • Cataracts
  • Hearing loss
  • Excessive ear wax
  • Dry eyes
THANK YOU!
Recognizing Side Effects: Focus on Chemotherapy

M. Kelly Nicholas, MD, PhD
Associate Professor of Neurology and Surgery
Director, Neuro-Oncology Service
Medical Director, The Brain Tumor Center
University of Chicago
Chemotherapy Side Effects

• Every Year, new drugs are added to the list of available chemotherapies.
• With them, come new side effects.
• Furthermore, combinations of new drugs can produce unexpected (and unwanted) results.

• Conventional chemo
  • Nausea
  • Low counts
• Targeted agents
  • Diarrhea
  • Rashes
• Monoclonal antibodies
  • High blood pressure
• Vaccines
  • Muscle and joint pain
Understanding Side Effects

• One of the biggest challenges for the doctor is distinguishing a treatment side effect from a tumor symptom.

A strong grasp of how the brain is organized is essential.
Distinguishing Side Effects from Tumor Effects

Tumor in each place can cause vision loss.

But new leg weakness was due to something else.
Is it a Chemo Side Effect?

- Sometimes it’s easy:
  - Transient nausea and vomiting after chemo
    - arrow
- Sometime’s it’s not:
  - Nausea and vomiting with a headache after chemo that doesn’t go away
    - circle

Chemo passes through the nausea sensor in the brain

Tumor causes hydrocephalus

American Brain Tumor Association
Providing and pursuing answers

2012 American Brain Tumor Association Patient and Family Conference
Is it a Chemo Side Effect?

- Sometimes it’s easy:
  - Symmetric peripheral neuropathy
- Sometimes it’s not:
  - Asymmetric peripheral neuropathy

This child with NF-1 and an optic glioma was getting carbo and vincristine when she developed left arm numbness.
Is it a Chemo Side Effect?

- Chemo fog vs. long term side effects.

This patient with primary CNS lymphoma had radiation when first diagnosed and high-dose chemotherapy at relapse. Following treatment with chemotherapy he said he was having trouble concentrating and his "memory was "off". He thought it was chemo fog. A brain MRI and biopsy of a large region of abnormality revealed scarring from prior treatment.

THIS IS A CHEMO SIDE EFFECT, IT’S JUST NOT CHEMO FOG!
Is it a Chemo Side Effect?

- Chemo fog vs. other effects

This patient, also with recurrent medulloblastoma had high dose chemotherapy followed by a bone marrow transplant. She said she never felt the same afterwards. She attributed this to chemo fog and missed an appointment for an MRI scan. A few months later, when she wasn’t any better, she went for a scan and the white spot on her brain turned out to be post transplant lymphoproliferative disorder (PTLD) that went away when her medications were changed.
Is it a Chemo Side Effect?

• Chemo fog vs. other effects

A woman with brain metastases got lots of chemotherapy followed by brain RT. She vomited a lot and had no appetite. She lost a lot of weight. Her family noticed she couldn’t remember anything. They thought it was chemo fog.

It turned out to be a vitamin deficiency (Thiamine/B1) and she got somewhat better with vitamin replacement.
What do These Stories Tell Us?

- Chemo side effects are common.
- They can occur during or after treatment.
- They can be difficult to figure out.
- So:
  - Don’t assume anything.
  - If a new symptom arises, don’t ignore it.
  - Tell your healthcare team.

Together we will get there.
Managing Acute and Late Side Effects of Radiation Treatment

Daniel Golden, MD
Chief Resident
Department of Radiation Oncology
University of Chicago Medical Center
Disclosures/Conflicts of Interest

• None

• About me:
  • Grew up in Oakland, California
  • Went to medical school at the University of Illinois
  • Currently radiation oncology chief resident at the University of Chicago (5 years of training)

• Still a 49ERS and A's fan
Goals

• Review early and late side effects

• Discuss management for the most common side effects
Acute (early) side effects

- During treatment → first 1-2 months after treatment
  - Headache
  - Nausea/vomiting
  - Skin irritation
  - Hair loss
  - Sore throat, dry mouth
  - Fatigue
Late side effects

- Months to years after treatment
  - Severe, extremely rare
    - Brainstem damage
    - Blindness (retina damage)
  - Severe, rare
    - Radionecrosis (tissue death caused by radiation)
    - Stroke
Late side effects

• Months to years after treatment
  • Less severe, more common
    • Cognitive changes
    • Endocrine abnormalities (hypothalamus and pituitary damage)
  • Cataracts
  • Hearing loss
  • Excessive ear wax
  • Dry eyes
Goals

• Review early and late side effects

• Discuss management for the most common side effects
Managing Early Side Effects

- **Headache, nausea, vomiting**
  - Steroids (dexamethasone)

- **Skin irritation**
  - Radiaplex, aquaphor

- **Hair loss**
  - “Tincture of time”

- **Sore throat**
  - “Magic mouthwash” (lidocaine, maalox, carafate)
Managing Late Side Effects

- Radionecrosis
  - Steroids (dexamethasone)
  - Surgery
  - Bevacizumab (Avastin)
  - Hyperbaric oxygen
Managing Late Side Effects

• Stroke
  • Difficult to “prevent”
  • Remain active
  • Time between onset of symptoms and treatment effects outcome
  • Know the warning signs of a stroke
    • FAST
Signs of a stroke

FACE:
Ask the person to smile. Does one side of the face droop?

ARMS:
Ask the person to raise both arms. Does one arm drift downward?

SPEECH:
Ask the person to repeat a simple phrase. Is their speech slurred or strange?

TIME:
If you observe any of these signs, call 9-1-1 immediately.

http://www.stroke.org
Managing Late Side Effects

- **Cognitive impairment**
  - Generally mild
  - Depends on radiation dose, region and amount of brain treated
  - Difficult to quantify
    - Requires specialized neurocognitive testing to detect an impairment
Managing Late Side Effects

• **Cognitive impairment**
  • Solution?
  • Generally mild, may not notice anything
  • “If you don’t use it, you lose it”
  • Sudoku, crosswords, brainteasers, etc.
  • Read a book
Managing Late Side Effects

- **Cognitive impairment**
  - Ongoing efforts to reduce this as a side effect
  - Sparing of the hippocampus
    - The “memory center” of the brain
Managing Late Side Effects

- **Hearing loss**
  - Usually worse for high-frequency sounds
  - Hearing aids may help

- **Cataracts**
  - Surgery
THANK YOU!
Managing Side Effects: Focus on Chemotherapy

M. Kelly Nicholas, MD, PhD
Associate Professor of Neurology and Surgery
Director, Neuro-Oncology Service
Medical Director, The Brain Tumor Center
University of Chicago
Managing Chemo Side Effects

- Medically
  - We have many ways to manage the side effects of treatment.
  - What we do depends on the specifics.
  - What you tell us is essential!

- Through lifestyle
  - Sometimes, changes in your behavior are either better than or complimentary of medical intervention.
Managing Chemo Side Effects: Nausea and Vomiting

• Medically
  • Ondansetron and similar drugs
  • Dexamethasone
  • Ativan and similar drugs
  • Compazine and similar drugs
  • Marinol

• Through lifestyle
  • Timing is (almost) everything
  • Watch what you eat and when you eat it
  • Get the rest you need
  • Listen to your body
  • Psych yourself up in the right way
Managing Chemo Side Effects: Constipation and Diarrhea

**Medically**
- Stool softeners
- Laxatives
- Enemas
- Anti-diarrheal drugs

**Through lifestyle**
- Consider what you eat and when you eat it
- The same for fluids
- Know bathroom locations!
- Don’t stray too far when your inner voice tells you not to
Managing Chemo Side Effects: Fatigue

• Medically
  • Sleep aides
  • Energy boosters

• Could you have a sleep disorder?

• Through lifestyle
  • Get the rest you need
  • Give yourself a break!
  • Listen to your body
    • Sometimes a little exercise helps
      • A relaxing walk or a little swim
    • Other times, it’s a nap that does the trick
Managing Chemo Side Effects: Keeping Tabs on the Silent Ones

- Low counts
  - Don’t miss your blood draws
  - Tell your team if you notice new bleeding or bruising
  - Mind a sore throat, fevers, or chills.
  - Fatigue can be caused by anemia

- Side Effects caused by newer drugs
  - Treat hypertension
Managing Chemo Side Effects Over Time

• Not every cycle will be the same
  • You may come to recognize patterns
    • You can take steps to minimize effects
  • Despite this, you may not handle some cycles as well as others
    • Cumulative toxicity
    • Sometimes, you’re just not up for it
      • Forgive yourself
      • Be good to yourself
      • Listen to your body
THANKS!