Emergency Management in a Radiation Oncology Clinic

Protecting Yourself and the Patient

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Disclosures

• No professional conflicts of interest to disclose
• No research is presented here which benefits from the support of any provider, commercial or otherwise
What is an Emergency?

- A situation which poses clear and immediate danger to life
- Immediate intervention and action is required to prevent worsening of the scene
- Often involves acute circumstances
- Uncontrolled
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*Does not need to be a surprise or unforeseen*
Goals

1. Radiation: understanding, potential hazards, and proper techniques for emergent patient care
2. Response: formulating appropriate actions for acute emergencies; procedures and references
3. Resolution: specific examples
4. Discussion: applying the learned techniques
Radiation

What exactly are you dealing with?
Understanding Radiation as a Tool

- Radiation is not always dangerous, but must always be respected
- Radiation is colorless, odorless, tasteless, invisible, painless, and silent
- May be deeply penetrating
- May bounce around corners and under doors

How do we know where the radiation is?
Understanding Radiation as a Tool

• US National Council on Radiation Protection allows:
  
  50 mSv/yr for radiation workers
  
  5 mSv/yr for members of the public

• Background radiation is 6.2 mSv/yr*

• Risk of cancer above background is $5 \times 10^{-5}$ per mSv**

** ICRP Report no. 60, 1990 (http://www.icrp.org/publication.asp?id=icrp%20publication%2060)
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- Risk of cancer above background is $5 \times 10^{-5}$ per mSv (0.005%)**

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Understanding Radiation as a Tool

Two types of radiation in the clinic:

• Radiation Producing Machines
  • Only produce radiation when they are turned ON and may be switched off in the event of an emergency

• Radioactive Materials
  • Produce radiation through natural decay and are always emitting radiation
Understanding Radiation as a Tool

- Two types of radiation in the clinic:
  - Radiation Producing Machines
    - **Xray units**
    - Fluoroscopy
    - CT machines
    - Linear Accelerators
  - Radioactive Materials
    - PET and SPECT
    - Nuclear Medicine
    - HDR and LDR
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Understanding Radiation as a Tool

- Signs and Placards
Potential Hazards

- Deviation from the Radiation Protection Program (RPP)
- Careless staff or patients
- Accidental exposure to radiation producing machines
- Spill and leaks
- Improper storage or handling of RAM
- Radioactive patients (nuclear medicine or sealed implant)
- Incorrect response to emergent scenarios
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**EYES UP, ACCIDENTS DOWN**
Proper Techniques for Care

TIME + DISTANCE + SHIELDING
Proper Techniques for Care

**TIME + DISTANCE + SHIELDING**

- **Time:** Reduce your time spent near the source. Dose is function of time.
- **Distance**
- **Shielding**
Proper Techniques for Care

**TIME + DISTANCE + SHIELDING**

- **Time**
- **Distance:** Increase your distance from the source. Exposure falls off as the square of the distance.
- **Shielding**
Proper Techniques for Care

TIME + DISTANCE + SHIELDING

• Time
• Distance
• Shielding: Use shields whenever they are available. Shielding reduces exposure.
Response

What should I do?
Acute Response

Emergencies: Work down from wide view to narrow view

1. Assess the Scene
2. Assess the Victims
3. Contain the Hazards
Acute Response

1. **Assess the Scene**
   - Protect yourself. Do not become a victim. *Scene safe?*
   - Identify hazards and victims
   - Activate 911 or internal emergency services
   - Establish clear oversight
   - Form a plan of action prior to engaging

2. **Assess the Victims**

3. **Contain the Hazards**
1. Assess the Scene

2. Assess the Victims
   - Identify nearby sources of radiation. Be aware of potential contaminations
   - Remove or contain sources if possible and practical, to reduce internal exposure to the patient
   - Remove the patient if possible and practical, to reduce external exposure to staff and the patient
   - Initiate ALS/BLS procedures: ABC’s, Conscious and Sustainable?
   - Assess exposure to the patient and local radiation injuries/burns, if present

3. Contain the Hazards
Acute Response

1. Assess the Scene
2. Assess the Victims
3. **Contain the Hazards**
   - Alert the Radiation Safety Officer (RSO)
   - Secure the radiation sources
   - Survey yourself and the patient prior to removal
   - Close the rooms around the source and post placards
Acute Response

1. Assess the Scene
2. Assess the Victims
3. **Contain the Hazards**
   - Avoid tampering with the scene, particularly if there is a victim
   - Law enforcement, the RSO, and/or the manufacturer may need to investigate the emergency
Acute Response

1. Assess the Scene
2. Assess the Victims
3. Contain the Hazards
   - Clearly document as much as you can remember
   - Record times and distances you spent near radiation, and record the same for your patients
   - RSO will notify the State or NRC, as needed
   - RSO will notify the manufacturer of your sources and equipment as needed
Building Your ERMP

• Every facility should have an Emergency Response and Management Plan (ERMP)
• The ERMP should be written by a multi-departmental team
• Include members from every area of the care team:
  - Physics & Radiation Safety
  - Nursing
  - Therapy
  - Dosimetry
  - Administration
  - Clerical Staff
  - Building Security and Facilities, as available
Building Your ERMP

Some example features of Your ERMP*

1. Radiation exposure should be considered in triage
2. Be prepared for a large number of victims and widespread contamination
3. Know how to set up an area for treatment of radiation incident victims
4. Include procedures for reducing contamination
5. Know how to approach and decontaminate exposed individuals

Building Your ERMP

- Be creative in identifying possible emergencies
- Consider compounded emergencies: Multiple emergencies happening concurrently
- *Give each member of the planning team an equal voice*
Building Your ERMP

Resources:

  OSHA Principal Emergency Response and Preparedness (osha.gov/Publications/osha3122.pdf)

• Radiation Protection Program and byproduct possession:
  10 CFR 35, and 10 CFR 20

• Emergency Planning per professional consensus:
  ACR Disaster Preparedness for Radiological Professionals, 2006
  AAPM Report no. 53 Radiation Information for Hospital Personnel, 1995

• Risk Analysis and Failure Mode Identification (applicable in building your ERMP):

• Example Emergency Response Plans per FEMA:
  fema.gov/media-library/assets/documents/89518
“Be a do-er!”

President Theodore Roosevelt

Maybe.

Resolution

Putting the process to work.
Equipment Related Emergency

- Equipment failure
- Power outage
- Collisions
- Lost radioactive sources
- Equipment catching on fire or getting wet
- Wedges, shields, applicators falling on patient
- Dropping patient from a lift; staff slips and falls

Primealert 35, and the Victoreen 451P, are proprietary holdings of Fluke Biomedical. Images are used here without endorsement.
Equipment Related Emergency

Example: A patient who is under treatment for a lung tumor is being imaged for brain mets using MRI due to altered mental status.

The patient experiences difficulty breathing, leading to severe anxiety and escalating symptoms.

Imaging tech alerts a nurse who responds hurriedly...
Equipment Related Emergency

Photo Credit: https://practicalfmri.blogspot.com/2012/09/intense-stray-static-magnetic-field.html
Patient Related Emergency

- Cardiac events
- Seizure or Stroke
- Catastrophic bleeding
- Respiratory distress
- Choking and suffocation hazards
- Discovery of collapsed lung or contrast leakage
- Altered mental status
- Violent or aggressive patients
Patient Related Emergency

Example: A patient is receiving T&O brachytherapy using an Ir-192 radioactive source
Patient Related Emergency

Example: A patient is receiving T&O brachytherapy using an Ir-192 radioactive source.

During treatment (source extended) the patient begins to moan and waive her arms, yelling out that she is experiencing terrible pain in her abdomen...
Patient Related Emergency

- Activate the emergency stop button
- Designate a timer
- Physician and physicist enter the vault
- Physicist surveys for the source
- If source is found physician signals nursing and triage begins
- If source is not found, physician removes applicator and physicist continues surveying
- If patient is clear they can be removed from the vault

- What if this were an LDR implant?
Act of God Emergency

- Flooding
- Hurricane
- Tornado
- Earthquake
- Wildfire
- Lightning

Photo Credit: Unknown. Huntsville AL, 2011
Act of God Emergency

Example: In 2011 a line of severe thunderstorms and tornadoes crossed Alabama killing more than 200 people. In Huntsville, electricity was lost for nearly a week...
Discussion

Talking through a group example.
A patient is administered \(^{18}\text{F})\text{FDG}\) for a PET/CT scan and sent to the uptake room. A few minutes later he suffers angina and collapses.

A second patient in the uptake room alerts the staff...
Thank you!

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