Radiation Safety
Dialysis Patient
2020

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Radiation Safety
Electromagnetic Spectrum
Radioactive ‘Signatures’  
Unique to each Radioisotope

- Half Life
  - Physical
  - Biological
  - Effective
    - Effective $T^{1/2} = \text{Physical } T^{1/2} - \text{Biological } T^{1/2}$

- Energy
Types of Ionizing Radiation

- Alpha Particles
- Beta Particles
- Gamma Rays
- X-Rays
- Neutron
Gamma Ray

- Electromagnetic radiation emitted from the nucleus
- Gamma emitters
  - Technetium $^{99m}$
  - Iodine $^{123}$
  - Iodine $^{131}$
- No mass and No charge
- Long Range
Sources of Radiation

- **Natural Occurring Sources**
  - Radioactive substances in the Earth’s crust (e.g., Uranium)
  - Radioactive gases (e.g., Radon)
  - Cosmic Radiation
  - Trace Radiation in the Body

- **Man-Made Sources**
  - Cyclotron Produced
  - Reactor Produced
  - X-Ray Producing Machines
Radioactivity Measurements

- **Quantity Measurements**
  - Curie (Ci) usually in milliCuries (mCi)

- **Exposure Measurements**
  - Millirem (mrem): 1000 mrem = 1 rem

- Other units used outside of the United States
Radiation Exposure
‘Natural or Occupational Sources’

- Background Radiation in San Francisco
  - 420 mRem/year or 1.2 mRem/day
- Eating one Banana
  - 0.01 mrem
- Flying
  - 0.5 mrem/hour
- Living in a Brick Home
  - 7 mrem/year
- Living in Denver
  - 50 mrem/year
- Airline crew
  - 500 mrem/year
- Nuclear Technologist
  - 1000 mrem/year
- Smoking 1 pack/day
  - 1800 mrem/year
Radiation Exposure from Medical Procedures or External Monitoring Sources

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Radiation Exposure (mrem)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSA Clearance at Airport</td>
<td>0.0011</td>
</tr>
<tr>
<td>Dental X-ray</td>
<td>0.03</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td>10</td>
</tr>
<tr>
<td>Mammogram</td>
<td>45</td>
</tr>
<tr>
<td>Head CT</td>
<td>200</td>
</tr>
<tr>
<td>Cardiac Catheterization</td>
<td>1,000</td>
</tr>
<tr>
<td>Nuclear Cardiology</td>
<td>1,600</td>
</tr>
</tbody>
</table>
Radiation Protection Philosophy

UCSF Philosophy

ALARA = As Low As Reasonably Achievable

- Time
- Distance
- Shielding
- Good Hygiene
Time

- Decrease Exposure by Decreasing your time next to a radioactive source
DISTANCE: Inverse-Square Law & Exposure Reduction

1 “Relative” Distance unit

Double the distance:
2 Distance units

1 unit of Dose Rate

1/4 of Dose Rate

Primary Beam or Source
UCSF Shielding of Rooms

- **Parnassus Hospital**
  - Two Rooms
    - Bone Marrow Transplant rooms on 11 Long
  - Lead Shielding in rooms and door
  - Accommodates therapies to 450 mCi

- **Mission Bay Hospital**
  - Three Rooms
    - One Room on Fifth floor in Women’s Hospital
    - Two Rooms on Six floor in Pediatric Oncology
  - Lead Shielding in rooms and door
  - Accommodates therapies to 1,000 mCi
Exposure vs Contamination

- **Exposure**
  - Patient is the source of radiation exposure

- **Contamination**
  - Patient is source of potential contamination
  - Contained in all body fluids (primarily urine)

Candle Analogy
Monitors to Measure Radiation

- **Personal Landauer Dosimeter Badges**
  - Returned Monthly/Quarterly for Analysis
  - Used for staff working around radiation
    - Exceeding 100 mRem/Year
  - Dosimeter for pregnancy

- **Electronic Dosimeters**
  - Immediate Reading of Exposure
  - Worn by staff going into patient’s room

- **Survey Meters for Patient/Area Survey**
Radiation Limits

- **Occupational Exposure**
  - Whole Body
    - 5,000 mrem/year
    - 15 mRem/day for Nurses/Staff
      - Change from time based exposure in the past to more accurately determine exposure
      - Nurses/staff may receive more if they are not daily caring for radiation patient
  - Pregnant Worker
    - 500 mrem during pregnancy with fetal badge and body badge

- **General Population**
  - 500 mrem/year
  - UCSF limits set at 100 mrem/year
Radiation: Safe or Not?

- Depends!!
  - Dose
  - Exposure Time Period
  - Health Effects
    - We know there are health effects from radiation exposure that exceeds 100,000 mRem
Room Preparation

- How are Radiation Patient Rooms Different?
  - Lead Lined
  - Plastic Wrapped
- Availability
- Room Set Up
- Room Tear Down
Caring for Therapy Patients

- Restrictions
  - No Pregnant STAFF or Caregivers
  - Exposure limit in Room is the CRITICAL factor

- PPE Necessary

- Lead/Bismuth Aprons not appropriate to use in these settings

- Entering Room Protocol

-Exiting Room Protocol
PPE Donning Procedure

1. Booties
2. Hand Sanitizer
3. Put on Electronic Dosimeter (under gown)
4. Gloves
5. Gowns (Yellow gown if no suspected body fluid situation, Blue Chemo gown if there is any chance of body fluid)
PPE Doffing Procedure

1. Remove first pair of gloves
2. Survey second set of gloves. If clean, continue.
3. Survey gown. If clean, remove, dispose in PPE waste bin, and continue.
4. Survey booties. If clean, remove as you step off protective flooring into hall, dispose of in PPE waste bin, and continue.
5. Remove gloves. Dispose of in PPE waste bin.
6. Record reading on Electronic Dosimeter in binder
PPE Procedure if Contamination is Discovered

If contamination is found, remove layer of protective garment and survey underneath. If under layer contaminated, alert another nurse immediately. Do not step out of room. Contact Radiation Safety.

In this dialysis situation, Radiation Safety will be on site during the entire procedure and will guide you along the way.
Specific Information

- Previous Room Situation
  - Patient was transferred to the Dialysis room for treatment.
  - Mobile lead shield transferred with patient

- Updated Rooms on 11 Long
  - Recent installation of dialysis ports in both rooms
  - Patient will remain in room
  - Dialysis staff will bring portable dialysis machine into room and set up on opposite side of mobile lead shield for protection
Specific Information

- Dialysis Team will meet with patient prior to therapy
  - Dialysis team will check patient’s dialysis access
  - Depending on which arm will be used, patient’s bed orientation may need to be changed

- Radiation Safety will add topical lidocaine to injection site 30 minutes prior to starting dialysis.

- Blood Draws prior to dialysis
  - Drawn by Dialysis Team
  - Extra tube drawn for radiation safety to determine count rate
  - All tubes marked with radiation sticker
    - Instructions added to Biohazard Bag for Clinical Lab
    - Radiation Safety will hand-carry tubes to STAT lab counter for processing
Radiation Safety Role during Dialysis Process

- Radiation Safety will be on site with Dialysis Team for entire process
  - Will help with donning and doffing procedure
  - Will help with monitoring radiation exposure and decreasing exposure techniques
  - Will measure radiation exposure readings of patient
  - Will be available for any questions during the process
Proposed Schedule

- 30 September 2020
  - Patient receives dialysis at outpatient facility
- 1 October 2020, Thursday
  - Patient admission and administering of I-131 for thyroid cancer therapy
- 2 October 2020, Friday
  - Blood measurements but dialysis may not be done
- 3 October 2020, Saturday
  - Inpatient Dialysis
- 4 October 2020, Sunday
  - Inpatient Dialysis with potential patient discharge to home
Previous Experience

- In thyroid therapy patients without ESRD, typical radiation exposure readings decrease by 50% within 24 hours of administering radioiodine (I-131)
- In patients with ESRD, there is very little natural excretions of I-131, so patient radiation exposure does not decrease other than the natural decay of I-131
- In patients with ESRD, patient’s radiation readings dropped by 50% after each dialysis procedure
Previous Experience

- Dialysis team caring for patient received less than 15 mRem of exposure for entire dialysis procedure.
- All disposable dialysis tubing will be discarded in patient’s room as radioactive waste.
- All sharps will go into sharps container in the room labeled with a radiation sticker.
- Intense monitoring of dialysis machines and dialysis discharge ports demonstrated NO contamination. Machines after standard cleaning were placed back into service.
Radiation Safety Resources

- Radiation Safety Team at UCSF EH&S
  - Six Health Physicist Specialists on staff
  - Always On Call 24-7
    - 628.777.6888

- Manuals on UCSF EH&S Website
  - Radiation Protection Handbook
  - Radiation Safety Manual
Exposure Numbers

- UCSF Radiation Safety supports all steps to reduce radiation exposure to staff
- Standard exposure for the Nursing team is less than 5 mRem a day and sometimes no more than 5 mRem for an entire treatment stay
Questions?