

Radionuclide Therapy- Radiation Safety Precautions

OVERVIEW AND TOPICS

- Patient and dose administrator precautions and dose administration methods of therapeutic procedures
- Administration methods for performing therapy with I-131 sodium iodide in either capsule or liquid form
- Precautions to be observed with low-dose I-131 therapeutic procedures
- Importance of good patient hygiene
- Precautions for dose administrator when administering a low dose of I-131 (<33 mCi)
- Considerations related to pregnancy, nursing, and child-care
- NRC recommendations for interruption of breast-feeding an infant
- Other considerations for minimizing radiation dose and contamination
- Precautions to be observed when the patient will be released shortly after administration of a high dose of I-131 NaI
- Precautions to be observed for high dose therapy for hospitalized patients
- Signage for room of hospitalized patient
- Procedures and precautions with a patient receiving Y-90 Zevalin
- Radiation safety aspects using Zevalin
- Precautions and procedures when administering P-32 and Sr-89
- Radiation safety aspects using P-32 and Sr-89

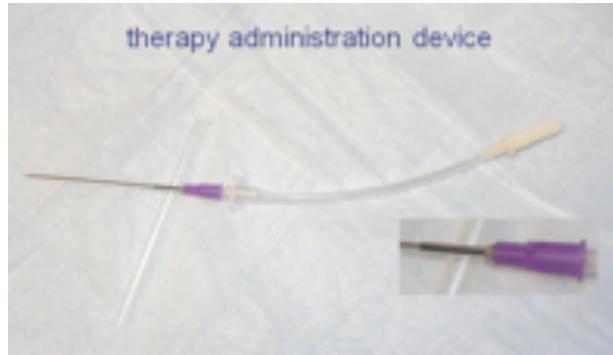
PART I. RADIONUCLIDE THERAPY WITH I-131 SODIUM IODIDE: PATIENT & DOSE ADMINISTRATOR PRECAUTIONS; ADMINISTRATION METHODS

1. Administration Method: I-131 NaI Capsules:

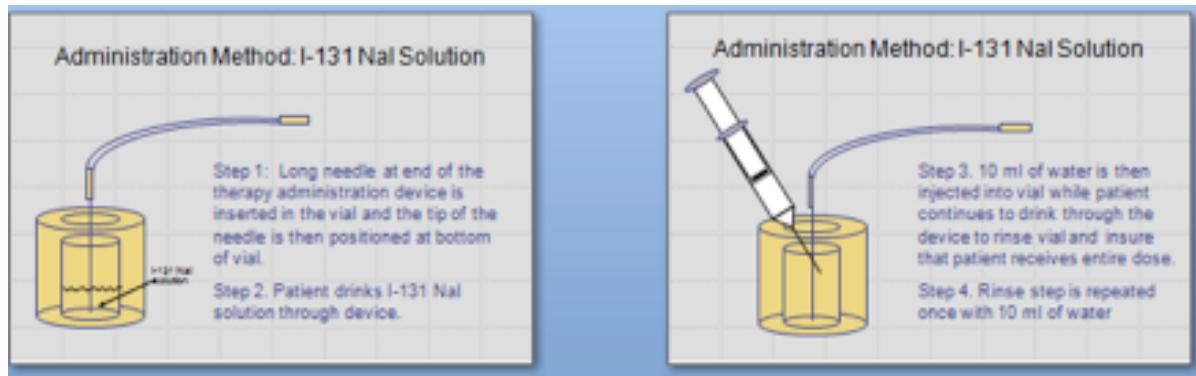
- Patient is NPO from midnight until appointment time next day
- Patient swallows capsule with a cup of water
- Patient remains NPO for at least one more hour
- Patient is given appropriate radiation safety instructions

2. Administration Method: I-131 NaI Solution

- Patient is NPO from midnight until appointment time next day
- Long needle at end of a special therapy administration device (see diagram below) is inserted into the vial and the tip of the needle is then positioned at bottom of vial.



- Patient drinks I-131 NaI solution through device.
- 10 ml of water is then injected into vial while patient continues to drink through the device to rinse vial and insure that patient receives entire dose.
- Rinse, then step is repeated once with 10 ml of water



- Patient remains NPO for at least one more hour
- Patient is given appropriate radiation safety instructions

3. Precautions to be Observed with Low-Dose I-131 Therapy Outpatient (according to the US NRC, a low dose is <33 mCi):

- Radiation Safety Concepts Regarding Radiation Exposure, there are three basic principles to keep in mind (the TDS Concept of Time, Distance, and Shielding)
- Minimize the time spent in close contact with others- radiation dose to another person is directly proportional to exposure time.
- The Inverse Square Law is your best friend! It is quick, simple, costs nothing, and is very effective. The guideline is simple: stay as far away as practicable from the radiation source. Radiation dose is inversely proportional to the square of the distance from the radiation source, so even relatively small increases in distance can make a significant difference in radiation dose. For example, moving from 3 feet away from a source to 5 feet away reduces radiation dose by 64%.
- While it is a good idea to place as much shielding as possible between you and the radioactive patient, this is usually not possible and therefore is the “weak link” in the chain of radiation protection when in close proximity to a patient who has been treated with I-131 NaI. Radiation dose decreases exponentially with an increase in shielding.

4. Patient Hygiene

- Good personal hygiene prevents contamination of others
- Good toilet hygiene prevents contamination of the environment
- Careful and thorough washing of your hands will reduce the possibility of contamination

5. Dose Administrator precautions for a patient receiving a low dose (<33 mCi)

- Keep your distance to minimize personal radiation dose
- Everyone involved with patient should wear a film badge
- Gloves must be used by the dose administrator, even if a capsule is being administered.
- Recommendation: monitor thyroid of therapy participants at 24-72 hr post dose. According to the current NRC regulations, there is no longer a specific requirement to monitor the thyroid of the dose administrator at 24-72 hours post administration of the dose. The regulations now simply state that there must be “timely monitoring of the dose administrator” with no clarification of what that means.
- Patients are instructed to not share anything with anyone for 7-10 days

- Patients are instructed to sleep alone for the first 1-2 days after treatment. During this period, patients should avoid intimacy and prolonged physical contact.
- Patients must minimize contact with children and pregnant women- children and unborns are much more sensitive to the effects of radiation than adults.
- Male patients are instructed to sit while urinating to avoid contaminating the environment. Toilet should be flushed 1-2 times with the lid closed for the first 1-2 days.
- Radioiodine treatment is contraindicated during pregnancy.

6. Considerations related to pregnancy, nursing, and child-care

- If a patient is planning to become pregnant after receiving I-131 NaI therapy, therapists typically recommend a waiting period of 6-12 months following treatment.
- Ideally, an adult other than the patient should care for a baby for at least 3 days following treatment. If not possible, then patient can do everything necessary, except breast feeding. This activity must stop and may not be resumed as radioiodine in breast milk may cause unwanted effects, e.g., an underactive thyroid
- During the first 3 days after treatment, the patient should minimize close contact, e.g., holding the baby in her lap, for more than a short time.

7.Nursing Guidelines:

- US NRC Regulatory Guide 8.39 states that following an administration of I-131, complete cessation of breast feeding is recommended for this child.
- All other radiopharmaceuticals have a recommended time period, after which nursing may resume. Tc-99m and I-123 compounds, for example, typically have a recommended 6-24-hr period of cessation of nursing.
- Recommended Duration of Interruption of Breast-Feeding from US NRC Regulatory Guide 8.39, Table 3 is presented in the chart below *

I-131 NaI	Complete cessation (for this infant or child)
I-123 mIBG	24 hr for 10 mCi; 12 hr for 4 mCi
Tc-99m MAA	6 hr for 4 mCi
Tc-99m Pertechnetate	24 hr for 30 mCi; 12 hr for 12 mCi
Tc-99m Red Blood Cells	6 Hr for 20 mCi
Tc-99m Sulfur Colloid	6 Hr for 12 mCi
Ga-67 Citrate	1 month for 4 mCi
In-111 White Blood Cells	1 week for 0.5 mCi
Tl-201 Chloride	2 weeks for 3 mCi

*** The duration of interruption of breast-feeding is selected to reduce the maximum dose to a newborn infant to less than 1 millisievert (0.1 rem), although the regulatory limit listed in 10CFR Part 35 Section 35.75 is 5 millisieverts (0.5 rem). The actual doses that would be received by most infants would be far below 1 millisievert (0.1 rem). Physician discretion may be used.**

8. Other considerations for minimizing radiation dose and contamination

- Wash hands thoroughly with soap and plenty of water each time toilet is used.
- Keep the toilet especially clean. For the first day or two, be sure to flush it 2 or 3 times after each use.
- Rinse the bathroom sink and tub thoroughly after you use them. Clean bathroom habits will reduce the chances of others becoming contaminated by the radioiodine in saliva and sweat.
- No one else should be able to accidentally use patient's personal effects (toothbrush, washcloth, etc.) since iodine might be spread that way.
- Patient should be well-hydrated. It is therefore important to drink plenty of liquids such as water or juices. This increases frequency of urination and clearance of the radioiodine, thus lowering the whole body and internal organ radiation dose
- Patient should use disposable eating utensils for the first few days after treatment, or may wash utensils separately. This will reduce the chance of contaminating other family members with radioiodine.
- The NRC recommends using separate towels and washcloths and laundering bath towels, bed linens, and underclothing separately.
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9. Precautions to be observed with High-Dose I-131 Therapy patient when the decision has been made to release the patient shortly after the dose is administered

- Length of time for ride home should ideally be < 2 hours
- Patient sits in right rear seat of vehicle
- Maintain a 6 ft. distance from others at home for > 2 days
- Stay at home; don't go to work for > 2 days
- Use of a bathroom separate from others for > 2 days
- Live alone, sleep separate from others for > 2 days
- No visits with family and friends for > 2 days
- Drink plenty of fluids for > 2 days
- Dose to an adult living with patient and observing the above specified restrictions must be < 500 mRem. If total is calculated to be < 500 mRem, the patient may be released, based on conditions above. Reference: US Nuclear Regulatory Commission Regulatory Guide 8.39, April, 1997

10. Precautions to be Observed with High-Dose I-131 Therapy patient (> 33mCi) when the decision has been made to hospitalize the patient.

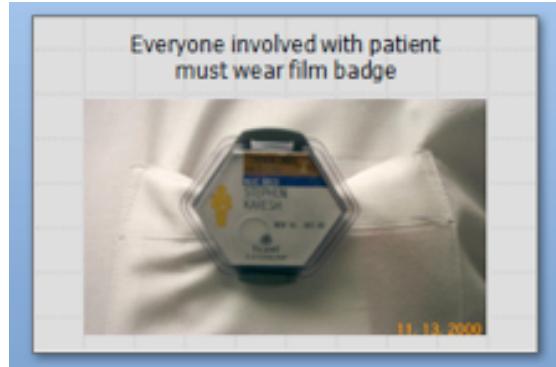
- Keep distance to minimize radiation dose



- Patient must be assigned a private room



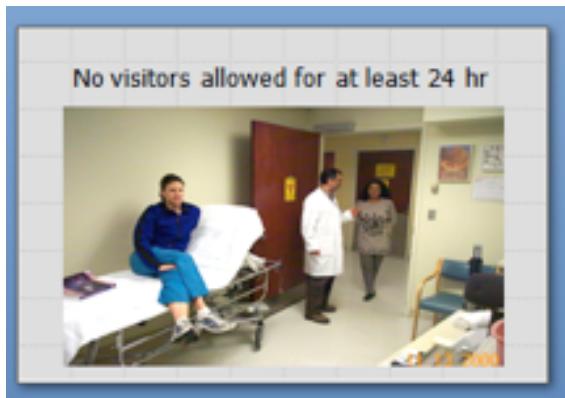
- Everyone involved with patient must wear film badge



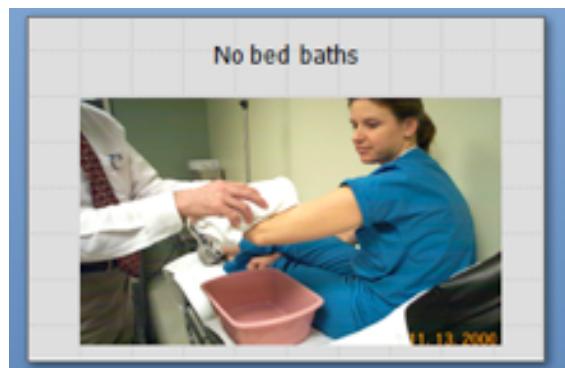
- Gloves must be used by patient to handle telephone, bed controls, radio/TV control or these devices must be covered with tape.



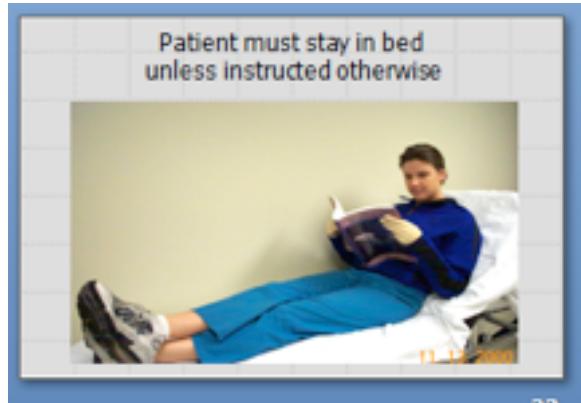
- Housekeeping not allowed in room until room is released by RSO
- No visitors for at least 24 hr (some practitioners permit 30 min visit)



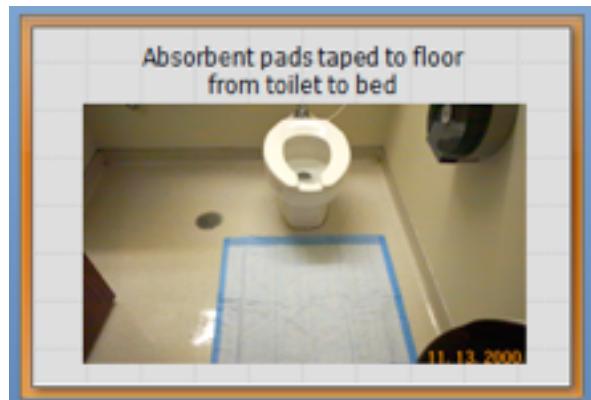
- No bed baths



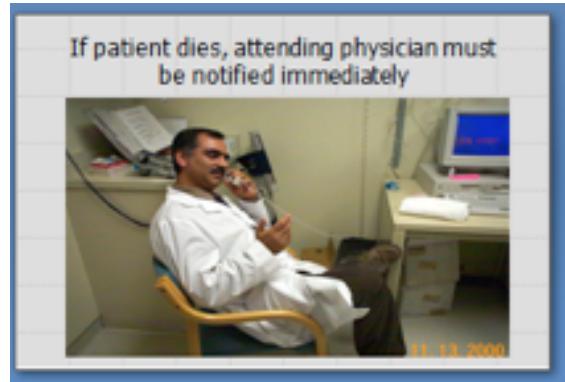
- Patient must stay in bed unless instructed otherwise



- Absorbent pads taped to floor from toilet to bed



- Patient must use disposable items for food service
- Diagnostic blood samples taken by Nuclear Medicine
- If the patient dies, notify attending physician immediately. In this extremely unfortunate situation, t_{eff} increases instantly from <1 day to the t_{phys} of 8 days, presenting significant radiation safety issues.



- Room must be surveyed by RSO prior to release for next use.



- Recommendation: every participant in therapy should have thyroid counted 24 hr post dose



- The NRC release criterion for patients treated with high-dose therapy for thyroid Ca with I-131 NaI is 7 mR/hr at 1 m from chest. A radiation reading of 7 mR/hr at 1 m from the chest correlates to a residual activity of approximately 33 mCi of I-131.
- The Agreement State release criterion for patients treated with high-dose therapy for thyroid Ca with I-131 NaI varies from 5 mR/hr at 1 m from chest to 7 mR/hr at 1 m from chest.
- For a hospitalized patient who was treated with I-131 NaI for thyroid cancer, most RSOs agree on the following signage:

Caution: Radiation Area



Caution: Airborne Radiation Area



Y-90 ZEVALIN

PART II. PATIENT AND DOSE ADMINISTRATOR PRECAUTIONS

1. Administration Method: Y-90 Zevalin

- A butterfly needle is placed in an accessible vein, usually the antecubital vein.
- The 20-32 mCi dose is administered intravenously over a 10-15 minute period followed by a 10 ml flush of 0.9% NaCl solution.
- The butterfly needle is removed and safely discarded in the appropriate hot waste bin
- Cover venipuncture site with a suitable sterile covering; leave in place for 1-2 hours.

2. Radiation Safety Aspects: Y-90 Zevalin

- Y-90 is a pure β - emitter. Risk of exposure from treated patient is minimal.
- Risk of radiation exposure to family members is also negligible. Most activity is retained in the body; urinary excretion = $\sim 1\%$ /day for first week.
- Assuming maximum 32-mCi dose and excretion of 7% over a week, total urinary excretion over a week = 2.3 mCi; activity per urination = microcuries.
- Ordinary amounts of blood (e.g., menstruation, bad cuts, hemorrhoids) will not contain appreciable levels of radioactivity. Isolation room not required at home
- Outpatient administration is without restrictions. There is no need to determine activity limits or dose rate limits prior to patient release. Patients can be released immediately after treatment
- Zevalin should be administered by physicians and other professionals qualified by training and experienced in the safe use and handling of radiopharmaceuticals (e.g., nuclear medicine physicians or radiation oncologists)
- Prospective study in 13 family members of patients treated with Zevalin was performed. Family members with closest contact wore personal dosimeter for 7 days and family was instructed to avoid body wastes, but no other precautions were given. Median deep dose equivalent over 7 days = 3.5 mrem (range, 1.4–7.9 mrem). Conclusion: exposure to others is negligible, much lower than our background radiation at sea level (300 mrem/year)
- Mayo Clinic Experience: Wiseman et al measured doses to personnel during preparation and infusion of 12 doses of 111-In Zevalin and 90Y Zevalin. The 111-In hand and body dose was <10 mrem; the 90Y hand dose (plastic shields used) had a median value of 50 mrem and a range 30-80 mrem. Conclusion: Exposures to healthcare workers can be low even when giving multiple therapies each year

3. Zevalin® Patient Release Instructions:

- For 3 days after treatment, clean up spilled urine and dispose of body-fluid-contaminated material so that others will not inadvertently handle it (i.e., flush down toilet or place in plastic bag in household trash)
- Wash hands thoroughly after using the toilet
- For 1 week after treatment, use condoms for sexual relations
- Use good contraceptive method for 1 year following Zevalin Therapy

Part III. Radionuclide Therapy: Patient and Dose Administrator Precautions When Administering With P-32 and Sr-89

1. Administration Method: P-32 Sodium Phosphate Solution

- A butterfly needle is placed in an accessible vein, usually the antecubital vein.
- The 4-mCi dose is administered intravenously over a 1-2 minute period.
- The butterfly needle is removed and safely discarded in the appropriate hot waste bin
- The venipuncture site is covered with a suitable sterile covering and left in place for 1-2 hours.

2. Administration Method: Sr-89 Chloride Solution

- A butterfly needle is placed in an accessible vein, usually the antecubital vein.
- The 4-mCi dose is administered intravenously over a 1-2 minute period.
- The butterfly needle is removed and safely discarded in the appropriate hot waste bin
- The venipuncture site is covered with a suitable sterile covering and left in place for 1-2 hours.

3. Radiation Safety Aspects: P-32 and Sr-89

- P-32 and Sr-89 are both pure beta emitters. Risk of exposure to personnel from treated patient is minimal, especially since only 4 mCi doses are typically administered.
- Risk of radiation exposure to family members is negligible. Most activity is retained in the body; urinary excretion is minimal.
- Isolation room not required at home

- Outpatient administration is without restrictions. There is no need to determine activity limits or dose rate limits prior to patient release. Patients can be released immediately after treatment
- These radiopharmaceuticals should be administered by physicians and other professionals qualified by training and experienced in the safe use and handling of radiopharmaceuticals (e.g., nuclear medicine physicians or radiation oncologists)
- For 3 days after treatment, clean up spilled urine and dispose of body-fluid-contaminated material so that others will not inadvertently handle it (i.e., flush down toilet or place in plastic bag in household trash)
- Wash hands thoroughly after using the toilet



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