

Radiation Safety Review

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- I. Radiation Safety Related to the Iodine-125 Prostate Seed Implant Procedure
- II. General Radiation Safety Instructions

I. Radiation Safety Related to the Iodine-125 Prostate Seed Implant Procedure

The implantation of radioactive seeds in the prostate gland requires an awareness of the general principles of radiation safety in a medical setting as well as some safety concerns that pertain specifically to this procedure. This lesson provides an overview of the procedure as well as these radiation safety concerns.

The procedure is one in which radioactive seeds are permanently implanted in the prostate where they give off their radiation, with the goal of controlling the cancer in the gland.

The Seeds:

The seeds contain radioactive element I-125. The I-125 seeds are small titanium cylinders with a diameter of about 1 mm and a length of almost 5 mm. The radioactive iodine is inside the small cylinder. In appearance, they resemble a short piece of lead from a mechanical pencil.

Iodine-125 gives off low energy x-rays, most of which are absorbed in the patient’s prostate tissue – this is the goal. A thickness of lead of about 1 mm will reduce the exposure to less than 0.1%. I-125 has a half-life of roughly 60 days so that it will decay in the patient to half of its strength in 60 days.

The seeds are ordered by the medical physicist and stored in a lead envelope in the Nuclear Medicine Department. Inside the lead envelope is a sterile pouch which contains a small glass vial with radioactive seeds. The physicist will visually inspect them and check them into the nuclear material inventory prior to taking them to the OR. During transport they will be in the lead envelope shield.

The Procedure:

In the OR, the physicist loads the seeds into needles that will be used to implant them. Typically there will be 4 or 5 seeds per needle and the seeds may be arranged in the needles using small plastic spacers that are the same size as the seeds. Generally 10-15 needles are used. This loading is done behind a lead shielded work area. Pregnant nurses should not be assigned to the patient’s case.

During the procedure, imaging is done using both ultrasound (via a rectal ultrasound probe) and intermittent fluoroscopy. Lead aprons including a thyroid shield must be worn by those in the OR to shield against fluoroscopy x-rays.

At the end of the procedure, the physicist will count and store any unused seeds and then use a survey meter to check for any seeds that may be present in surgical drapes, bedding, equipment etc. It is not uncommon to find a seed stuck in a removed needle, imbedded in a catheter or in the template. Any loose seeds are removed and stored by the physicist. A final radiation survey of the patient and the room contents is made and readings are recorded.

After the Procedure:

The patient is moved to an isolated recovery room and is typically released in a few hours. A radiation warning sign will be posted on the door by the physicist with additional instruction, emergency contact information and the measured radiation exposure at 1 meter from the patient. Time with the patient should be limited to only what is needed for routine nursing care. Pregnant nurses should not be assigned to the patient.

After the patient is released ALL linens, dressings and urine should be left in the room. If a seed is found while caring for the patient, (e.g. in the bedding) it should be picked up with forceps and placed in a container (in the patient’s room) until it can be retrieved by the covering physicist. The physicist will use a survey meter to check and remove any seeds from the room that may have been found. Finally, the physicist will post an ALL CLEAR sign when the room is cleared of any radiation from the procedure. At this time housekeeping may clean the room.

If for any reason, the patient is moved to another room/floor the old room should not be cleaned and the door should stay closed. The physicist should be notified to follow the patient to the new room, discuss any precautions with any new staff and post nursing instructions with the emergency contacts for the case.

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If the patient requires emergency surgery or dies immediately notify the medical physicist identified on the door posting.

II. General Radiation Safety Instructions

It is intended that workers who receive this instruction will develop respect for the risks involved, rather than excessive fear or indifference.

What is radiation? Ionizing radiation (e.g. x-rays, gamma radiation, and ultraviolet light) is electromagnetic radiation that has enough energy to break apart atomic structures and thus cause damage. It is generally understood that the term “radiation” usually refers to the “ionizing radiation”.

What is radiation dose? The term radiation dose describes the quantity of energy absorbed per unit mass. The commonly used radiation units that are used to measure radiation are:

Rad (or Gray): Absorbed radiation energy. This unit is used to describe the dose prescribed to treat a patient.

Rem: Absorbed dose equivalent. This unit is often used in radiation protection to quantify the biological dose received from different radiation types. We usually specify dose in milli-rem; abbreviated mrem which is 1/1000 of a rem.

Roentgen: Unit of radiation exposure in air. Most radiation survey meters measure this quantity which is related to the amount of dose one may receive. Usually measured as milli-Roentgen per hour.

Where do I find rules, regulations, and guidelines that apply to me? Regulations regarding the safe use of radioactive materials may be found electronically at NRC.gov under the following sections:

NRC Part 20 STANDARDS FOR PROTECTION AGAINST RADIATION

NRC Part 35 MEDICAL USE OF BYPRODUCT MATERIAL

Regulations regarding the safe use of radiation producing devices can be found at michigan.gov under the State of Michigan Radiation Safety Section. Additional help may be obtained by speaking with your radiation safety officer (RSO), radiation protection supervisor (RPS), or Medical Physicist.

What is a radiation safety officer or radiation protection supervisor? The RSO and RPS are identified by the institution as responsible for maintaining compliance with federal and state regulatory standards and guidelines and ensuring radiation safety in the workplace. Your RSO is listed on the Radioactive Material License. Your RPS is listed under the State Registration Certificate for the x-ray equipment used in your department. The RSO and RPS work with the radiation safety committee to keep the radiation dose to all individuals “As Low As Reasonably Achievable” or **ALARA**.

What is natural background radiation exposure? The average person is constantly exposed to ionizing radiation from several sources. Our terrestrial environment, cosmic radiation, and even the human body contain naturally occurring radioactive materials that contribute to the radiation dose that we receive. In Michigan, this background is about 300 mrem per year or about 1 mrem per day. The impact of this average annual radiation exposure cannot be measured conclusively due to the extremely low incidence of effects, but it is generally assumed that the low-level exposure carries insignificant health risk.

How much radiation am I allowed? Both the Nuclear Regulatory Commission and the State of Michigan allow up to 1250 mrem of exposure to radiation workers per quarter. Your medical institution is committed to making every reasonable effort to keep exposures less than 1/10 of the regulatory allowed dose or 125 mrem per quarter. Any employee who receives greater than this limit will be notified and the case reviewed by the radiation safety committee.

What are some typical exposures during procedures? The exposure to staff at 2 meters (~6.5 feet) from the patient is about 0.02 mrem from fluoroscopy and 0.01 mrem from radioactive seeds, for a total estimated exposure of 0.03 mrem. That is 3/100 of a millirem... much smaller than the average daily dose from background radiation.

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How can I minimize my radiation exposure? The three basic methods are to: (1) minimize unnecessary *TIME* near patients being fluoroscoped, or time near patients containing radioactive implants or drugs; (2) keep your *DISTANCE* as far as practical while providing the necessary care. Even a small increase in distance will reduce your exposure dramatically; (3) use *SHIELDING* whenever possible. This may include lead aprons, lead thyroid shields, leaded glasses or even other staff in the room who must work closer to the patient than you. Pregnant visitors and children under 18 are not allowed.

What if I see something that I suspect is radioactive? Call the Nuclear Medicine Department, Radiation Oncology Department or the Medical Physicist(s) listed below.

How is my radiation exposure monitored? Occupational radiation exposure is monitored with use of clip-on radiation badges, ring, and eye badges. The RSO or RPS are responsible for the assignment of radiation monitors. State regulations require monitoring of workers who are likely to exceed 300 mrem per quarter or individuals doing fluoroscopy. Obtain and wear a radiation badge.

What about exposure to the embryo/fetus? If an occupationally exposed woman declares her pregnancy in writing, she is subject to the more restrictive dose limit for the embryo/fetus during the remainder of the pregnancy. The dose limit of 0.05 rem (50 mrem) per month or 0.5 rem (500 mrem) for the total gestation period applies. In most cases radiation workers can continue their present job with no change in duties and still meet the dose limit for the embryo/fetus. However, to eliminate any risk, pregnant employees should not care for I-125 implant patients.

How do I declare pregnancy in writing and to whom? Notify your immediate supervisor, RSO, or RPS that you wish to declare your pregnancy. The appropriate declared pregnancy form will be provided to you. The radiation worker who has declared pregnancy will receive an assigned “fetal” radiation monitor, and will be instructed on the radiation safety practices and risks related to radiation exposure to the embryo/fetus. The declaration of pregnancy is voluntary. Also, the declaration of pregnancy can be withdrawn in writing for any reason.

If I have not declared my pregnancy in writing and my supervisor suspects that I am pregnant, does the embryo/fetus dose limit apply?No. Your employer may not restrict you from a specific job if you have not declared pregnancy.

Can normal occupational radiation exposure cause sterility or impotence? No. Temporary or permanent sterility cannot be caused by radiation at levels allowed under states occupational limits.

Who do I contact to report unsafe conditions? It is your responsibility to report promptly to the RSO or RPS any condition that may lead to or cause a violation of regulations or any condition that may cause unnecessary exposure to radiation or radioactive material.

For questions or concerns related to the surgical implantation of radioactive seeds, you may contact the Nuclear Medicine Department (East 894-3092) or the Radiation Oncology Physicist below:

Terry Dillon
Medical Physicist
Jeppesen Radiation Oncology Center
Office: 989-667-6670 or 989-667-6675

Matthew Buczek - Physicist 3/2017