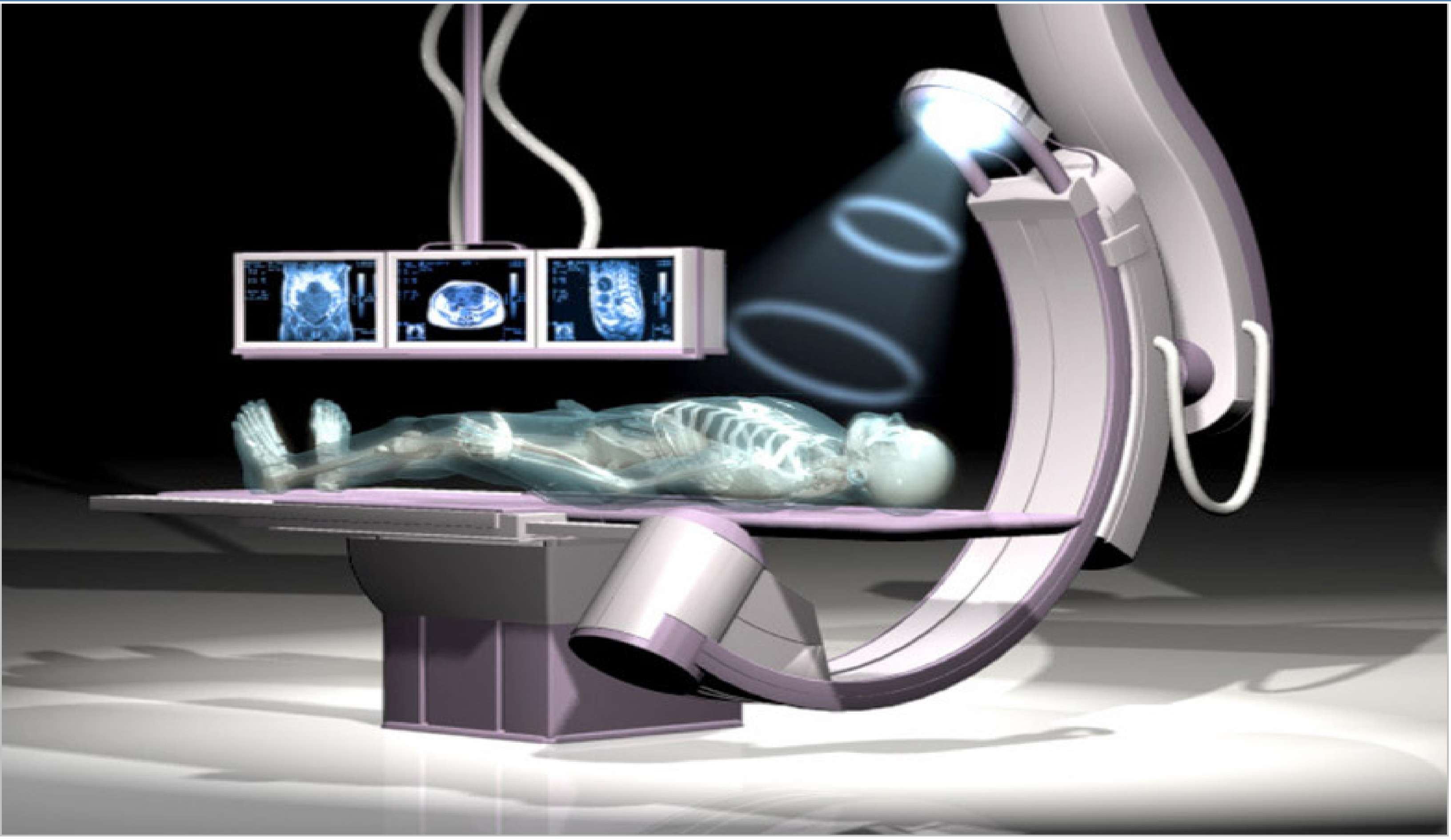
RADIATION SAFETY

for Surgical & Invasive Procedures



North Shore-LIJ Health System Perioperative Education

Radiation Safety for Surgical & Invasive Procedures

TABLE OF CONTENTS

Radiation Safety for Surgical & Invasive Procedures

Purpose

The purpose of this self-learning packet is to present operating room personnel with current information that will assist in reduction of and protection from radiation exposure during operative procedures.

Learning Objectives

Upon completion of this self-learning module, the learner will be able to:

1. Identify between radioactivity and radiation
2. Identify the three types of radiation
3. Discuss appropriate means to protect staff and patients from radiation exposure, and
4. Describe the proper care of protective apparel.
5. Describe the NSLIJHS Fetal protection policy during radiological procedures for healthcare workers.

Instructions

In order to receive credit, you must:

1 Complete the post test on Quia.com. The passing score is 100%.

Radiation Safety for Surgical & Invasive Procedures

Introduction

There are numerous types of settings in which perioperative nurses practice. These practice settings include traditional operating rooms, ambulatory surgery centers, physicians' offices, cardiac catheterization suites, endoscopy units, radiology and interventional radiology departments, and all other areas where operative and other invasive procedures may be performed.

Nurses and radiology personnel work as a team in the operating room when giving patient care, although they are not cognizant of the clinical education of the other. When they are poorly educated about radiologic safety, nurses may avoid being in the room. It is necessary to become aware of the safety measures that need to be taken to protect oneself and their patients.

Books, movies, and news media often depict radiation as a mysterious, deadly force. The truth is, there is nothing mysterious about radiation at all. Scientists have been studying it for at least 100 years. They know how to detect, measure, and control even the smallest amounts. Radiation is like many other things; the more we understand it, the less frightening it becomes. And when it's controlled, it is one of our most beneficial tools.

Radiation is measured in units:
Roentgen - unit of radiation exposure in air
Rad - energy absorbed per gram of material
Rem - biological effect of a rad
mRem – millirem = 1/1000 of a rem
Conceptually, the 3 units of radiation described above are entirely different, however, numerically they are approximately equal to one another. The standard unit of radiation protection is usually in millirems, which is $1/1000^{th}$ of a Rem.

Natural Background Radiation

From the beginning of time, the total population of the world has been exposed to natural background radiation. This radiation consists of basically 3 components: cosmic rays coming in from outer space; terrestrial radiation from the earth; building materials and internal radiation coming from the body itself. The total amount of background radiation that an average person in New York receives is approximately 300-400 millirems per year. This number will vary depending upon location, altitude, and the amount of natural radioactive material in the ground. The highest recorded background levels are in some mountainous regions of South America where they go as high as 1,000 mR per year. There are no known proven carcinogenic effects from radiation levels in the order of magnitude of natural background radiation. Keeping this in mind, one can conclude that exposures from man made radiation in the same order of magnitude as background radiation, should have no adverse effects on the human population.

1) New York City = 300 mR/year
2) Denver = 500 mR/year
3) Grand Central Station > 500 mR/year
4) Andes Mountains ~ 1000 mR/year or 1 R/year
5) One banana = 0.1 mR

Radioactivity and Radiation

All matter in our environment is made of atoms. Most atoms we encounter on Earth are stable. Some atoms, however, are unstable, giving off energy in the form of radiation in order to reach a stable state. These atoms are said to be **radioactive**. An example is the radionuclide, Carbon-14, produced in the atmosphere when cosmic rays interact with stable nitrogen atoms. When a Carbon-14 atom undergoes radioactive decay, it gives off radiation in the form of a beta particle and then becomes a stable nitrogen atom once again. The existence of Carbon-14 in all living things enables archaeologists to date ancient artifacts.

There are small amounts of naturally occurring radioactive substances in soil, rocks, plants, animals, and in our own bodies, all of which give off radiation. Large amounts of radiation are present in outer space and a small portion of this radiation penetrates the atmosphere. This low level of naturally occurring radiation is known as **background** radiation.

Radiation can only be detected by specially designed instruments. Radiation may pass through an object, or it may be absorbed and cause changes at the site of absorption. Radiation is known to cause cancer and birth defects in animals and humans. The risk of radiation damage is related to the amount of radiation absorbed by an individual.

> *Radiation is useful in medicine because of its ability to penetrate tissue, allowing imaging and non-surgical treatment of internal structures. However, radiation may produce harmful biological effects. Observations of exposed human populations and animal experimentation indicate that exposure to low levels of radiation over a period of years may lead to a slight increase in the incidence of cancer and leukemia. Exposures to high levels of radiation produce the same effects faster and may also cause hair loss, skin burns, radiation sickness or even death. Radiation may also increase the risk of genetic abnormalities.*

Types of Radiation

Radiation is classified into three categories, each of which requires protective shielding **(Figure 1).**

Primary radiation. The primary beam, or useful beam, is termed the *primary radiation.* Primary radiation is produced inside the x-ray tube isotropically (i.e. with equal intensity on all directions) at a point source known as the anode target.

The X-ray tube is a Pyrex glass vacuum tube that is encased in lead lined protective tube housing. The lead lined housing helps contain the x-ray photons and prevents unnecessary overexposure of the patient and personnel.

Primary radiation should never be pointed at anything other than the patient. You should not hold a patient while being radiated. This is because most lead aprons, although they protect from secondary radiation, offer little protection from primary radiation.

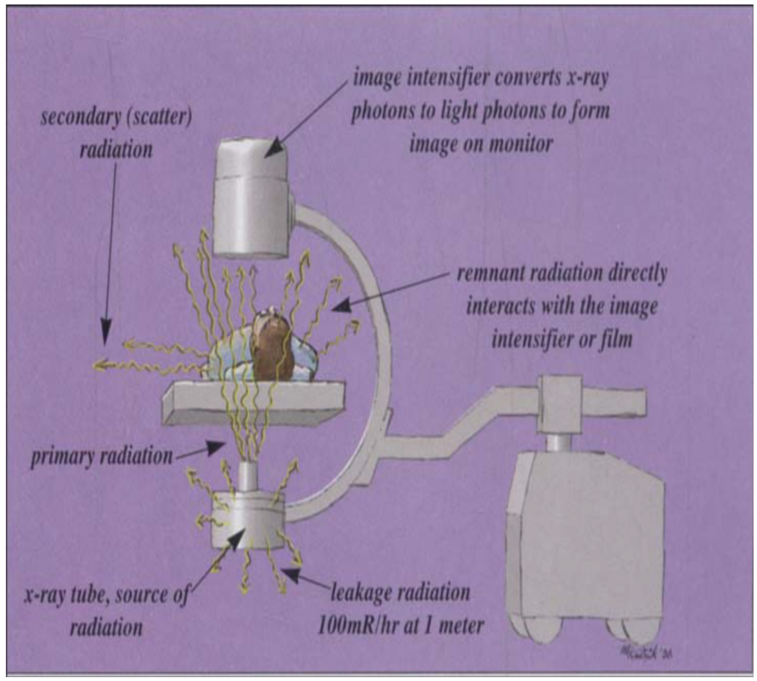


Figure 1 [9]
Types of radiation and their sources created during fluoroscopy. *(Illustrations by Mark Katnik, Denver)*

Secondary Radiation. This type of radiation is categorized as either scatter or leakage radiation. Scatter radiation results when the primary beam interacts with the patient, or any object in its vicinity, and is deflected or partially absorbed (i.e., attenuated). This attenuation causes a change in the direction of movement of the photon and a simultaneous loss of photon energy. Scatter radiation poses the biggest hazard to personnel in the room during exposure. The patient is the primary scattering object, and the larger the patient, the more scatter is produced. During fluoroscopy (i.e. C-arm), scatter radiation occurs from within the patient. Scatter will travel in the air till it is absorbed by matter. As the distance from the radiation source increases, the intensity of the radiation decreases. This is known as the inverse square law.

Remnant Radiation. Radiation that is not absorbed by the patient's body is called **remnant radiation**. This third type of radiation poses little threat to personnel because it is the radiation that exits the patient and imparts the image on the film.

Radiation Safety for Surgical & Invasive Procedures

Cardinal Principles of Radiation Safety

There are three principles of radiation protection practiced in radiology for dealing with live sources of radiation. These three principles are called the Cardinal Rules of radiation protection; they are: time, distance, and shielding from ionizing radiation. A fourth principle that applies directly to diagnostic imaging technologists who make static and fluoroscopic images, stay out of the primary beam unless you are the subject under study. The fifth and perhaps the most important principle is that of ALARA, an acronym for as low as is reasonably achievable radiation dose to the patient. These principles also assume that direct radiation exposure to the nurse/ technologist should not occur routinely as an occupational risk. The three principles are:

1. **Time**: Try to work as fast as possible while x-rays are on. In the case of physicians using fluoroscopy, short, quick exposures will result in drastic reductions in exposures to everyone in the room including the patient.
2. **Distance**: Distance offers great protection for any kind of radiation. All radiation falls off generally as the inverse square of the distance. This means that if you move twice as far away, the radiation exposure will drop by a factor of 4. In general, one should stand next to the source of radiation (patient) as little as possible, and if the technologist and nurses stand back approximately 6 feet away from the table, the radiation levels will drop drastically.
3. **Shielding**: Always stand behind a protective barrier (control booth) or wear a lead apron when performing x-rays. Lead aprons attenuate approximately 95% of scatter radiation.

Cardinal Principles of Radiation Protection

- ***Time*** **of exposure should be kept to a minimum.**
- ***Distance*** **between source and exposed as great as possible.**
- ***Shielding*** **should be worn or inserted between radiation sources and exposed.**

Protection from Radiation

Personnel Monitoring

Personnel monitoring refers to procedures instituted to estimate the amount of radiation received by individuals who work around radiation. Personnel monitoring is required when there is a likelihood that an individual will receive more than one tenth the maximum permissible dose (500 mR). Due to this, it is usually not necessary to monitor radiology secretaries and file clerks. Furthermore, it is usually not necessary to monitor operating room personnel.

The personnel monitor offers no protection against radiation exposure. It simply measures its quantity of radiation to which it was exposed and therefore is used as an indicator of its exposure of the wearer. Generally, the badge is worn on the collar and positioned above the protective apron during fluoroscopic procedures. Pregnant workers are to wear the badge at waist level to monitor fetal exposure.

Patient Protection

- During radiological procedures, the healthcare worker must ensure that their patient is protected from the radiographic ions. Especially in the areas that do not need to be radiated. During fluoroscopic or radiological procedures, care should be taken to protect the patients thyroid and lymph tissues which are known to be sensitive to radiation exposure.
- Lead shielding should also be used, when possible to protect the patients ovaries or testes (i.e.: gonads) during x-rays studies, including those performed on the hips and upper legs.
- Female patients of childbearing age should be questioned about the possibility of pregnancy. If the possibility of pregnancy exists, the surgeon and the anesthesiologist should be notified to determine the advisability of continuing or postponing the procedure. Lead shielding should be used to protect the fetus when other areas of the pregnant woman's body are x-rayed. During the preoperative assessment phase, the perioperative nurse should assess all pre-menopausal women to ensure that they are aware of the risks during pregnancy.

Proper handling and storage of Protective Apparel

Protective apparel is easily damaged by improper use and storage, and when damaged , its protective ability is compromised. When not in use, protective garments should be properly placed on a storage rack designed for this purpose. Personnel should avoid folding , dropping or piling these garments together as this leads to fracturing of the lead shield within the garment. Extreme heat or exposure to direct sunlight can also damage these garments. Garments that are worn, cracked, dried, or in any way damaged are ineffective in protecting personnel from radiation exposure. Periodic inspection and radiographic testing of these garments are done semi-annually to test the barrier capabilities. This will ensure the garments protective abilities.

AORN
RP: Reducing Radiological Exposure

Recommendation 1
The patient's exposure to radiation should be minimized.

4. All reasonable means of reconciling an incorrect sponge, needle, or instrument count should be attempted before using a radiological examination to locate a sponge, sharp, or instrument that is missing. Certain procedures, because of the complexity of the number of instruments used, may necessitate a post operative X-ray. Controlling the amount of total fluoroscopic beam "ON" time for these procedures through judicious control of the exposure time may help ensure that radiation exposure is as low as reasonably achievable.

Fetal Protection Policy

North Shore Long Island Jewish Health System has adopted a policy to protect the fetus/embryo of pregnant employees exposed to ionizing radiation in their work. Although it is not required in New York State for pregnant personnel to be removed from any radiation or fluoroscopic procedures, if a pregnant employee working in a radiation or radioisotope area chooses to formally disclose a pregnancy she must do so in writing as required by New York State Department of Sanitary Code Part 16.6. If an employee decides to declare her pregnancy, she should notify her supervisor nurse manager who will arrange for her assignments to be altered, if needed. You will need to refer to you facilities policy and procedure on fetal protection.

Conclusion

Radiography is crucial to the care and treatment of patients. Working with and around radiation can be safe, provided personnel are educated and know the risks of radiation and are up to date on protection practices.

References

AORN: Standards and Recommended Practices. *RP: Reducing Radiological Exposure*. 2008.

Astarita Associates, Inc. Medical Physics Consultants: *Radiation Safety Inservice,* 2007

Shymko & Shymko, *Radiation Safety; AORN Journal 68 no 4 (October 1998) 595-601*.