HEALTH PHYSICS SOCIETY

Specialist in Radiation Safety

RADIATION EXPOSURE FROM MEDICAL DIAGNOSTIC IMAGING PROCEDURES

HEALTH PHYSICS SOCIETY FACT SHEET

Ionizing radiation is used daily in hospitals and clinics to perform diagnostic imaging procedures. For the purposes of this fact sheet, the word radiation refers to ionizing radiation. The most commonly mentioned forms of ionizing radiation are x rays and gamma rays. Procedures that use radiation are necessary for accurate diagnosis of disease and injury. They provide important information about your health to your doctor and help ensure that you receive appropriate care. Physicians and technologists performing these procedures are trained to use the minimum amount of radiation necessary for the procedure. Benefits from the medical procedure greatly outweigh any potential small risk of harm from the amount of radiation used.

Which types of diagnostic imaging procedures use radiation?

- In x-ray procedures, x rays pass through the body to form pictures on film or on a computer or television monitor, which are viewed by a radiologist. If you have an x-ray test, it will be performed with a standard x-ray machine or with a more sophisticated x-ray machine called a CT or CAT scan machine.

- In nuclear medicine procedures, a very small amount of radioactive material is inhaled, injected, or swallowed by the patient. If you have a nuclear medicine exam, a special camera will be used to detect energy given off by the radioactive material in your body and form a picture of your organs and their function on a computer monitor. A nuclear medicine physician views these pictures. The radioactive material typically disappears from your body within a few hours or days.

Do magnetic resonance imaging (MRI) and ultrasound use radiation?

MRI and ultrasound procedures do not use ionizing radiation. If you have either of these types of studies, you are not exposed to radiation.

Do benefits from medical examinations using radiation outweigh the risks from the radiation?

Your doctor will order an x-ray test for you when it is needed for accurate diagnosis of your condition. Benefits from the medical procedure greatly outweigh any potential small risk of harm from the amount of radiation used.

There is no conclusive evidence of radiation causing harm at the levels patients receive from diagnostic x-ray exams. Although high doses of radiation are linked to an increased risk of cancer, the effects of the low doses of radiation used in diagnostic imaging are not known. No one is certain if any real risks are involved. Many diagnostic exposures are similar to exposure that we receive from natural background radiation found all around us. You will note that a few of the diagnostic exposures are much higher than background or that multiple exposures will give an accumulated exposure higher than background. Nevertheless, benefits of diagnostic medical exams are vital to good patient care.

What are typical doses from medical procedures involving radiation?

Radiation dose can be estimated for some common diagnostic x-ray and nuclear medicine studies. It is important to note that these are only *typical* values. Radiation doses differ for each person because of differences in x-ray machines and their settings, the amount of radioactive material given in a nuclear medicine procedure, and the patient's metabolism.

The tables below give dose estimates for typical diagnostic x-ray and nuclear medicine exams. For comparison, in the United States we receive about 3.0 mSv (300 mrem) of exposure from natural background radiation every year. The effective dose listed is a comparable whole-body dose from the exam. The effective dose is given in mSv and mrem, the SI unit of measure of the effects of ionizing radiation on humans followed by the same dose in traditional mrem.

Typical Effective Radiation Dose from Diagnostic X Ray—Single Exposure

Exam	Effective Dose mSv (mrem)[1]
Chest (LAT)	0.04 (4)
Chest (AP)	0.02 (2)
Skull (AP)	0.03 (3)
Skull (Lat)	0.01 (1)
Pelvis (AP)	0.7 (70)
Thoracic Spine (AP)	0.4 (40)
Lumbar Spine (AP)	0.7 (70)

Exam	Effective Dose mSv (mrem)[2]
Mammogram (four views)	0.7 (70)
Dental (lateral)	0.02 (2)
Dental (panoramic)	0.09 (9)
DEXA (whole body)	0.0004 (0.04)
Hip	0.8 (80)
Hand or Foot	0.005 (0.5)
Abdomen	1.2 (120)

The following table shows the dose a patient could receive if undergoing an entire procedure. For example, a lumbar spine series usually consists of five x-ray exams. CT stands for computed tomography and is sometimes called a CAT scan.

Complete Exams	Effective Dose mSv (mrem) [1]
Intravenous Pyelogram (kidneys, 6 films)	2.5 (250)
Barium Swallow (24 images, 106 sec. fluoroscopy)	1.5 (150)
Barium Enema (10 images, 137 sec. fluoroscopy)	7.0 (700)
CT Head	2.0 (200)
CT Chest	8.0 (800)
CT Abdomen	10.0 (1,000)
CT Pelvis	10.0 (1,000)
Angioplasty (heart study)	7.5 (750) - 57.0 (5,700)[3]
Coronary Angiogram	4.6 (460) - 15.8 (1,580)[3]

Typical Effective Radiation Dose from Nuclear Medicine Examination

Nuclear Medicine Scan	Radiopharmaceutical (common trade name)	Effective Dose mSv (mrem)[2]
Brain (PET)	^{15}O water	1.0 (100)
Brain (perfusion)	^{99m}Tc HMPAO	6.9 (690)
Hepatobiliary (liver flow)	^{99m}Tc Sulfur Colloid	2.8 (280)
Bone	^{99m}Tc MDP	4.2 (420)
Lung Perfusion/Ventilation	^{99m}Tc MAA & ^{133}Xe	2.0 (200)
Kidney (filtration rate)	^{99m}Tc DTPA	3.6 (360)
Kidney (tubular function)	^{99m}Tc MAG3	5.2 (520)
Tumor/Infection	^{67}Ga	18.5 (1,850)
Heart (rest)	^{99m}Tc sestimibi (Cardiolite)	6.7 (670)
Heart (stress)	^{99m}Tc sestimibi (Cardiolite)	5.85 (585)
Heart	^{201}Tl chloride	11.8 (1,180)
Heart (rest)	^{99m}Tc tetrofosmin (Myoview)	5.6 (560)
Heart (stress)	^{99m}Tc tetrofosmin (Myoview)	5.6 (560)
Various PET Studies	^{18}F FDG	14.0 (1,400)

How can I obtain an estimate of my radiation dose from medical exams?

Ask your doctor to refer you to a medical health physicist, diagnostic medical physicist, or your hospital's radiation safety officer for information on medical radiation exposure and an estimate of exposure.

Internet Resources

To read more about x-ray exams, go to http://www.radiologyinfo.org/. To read more about pregnancy and x rays, go to http://hps.org/publicinformation/radterms/.

References

1. Wall BF, Hart D. Revised radiation doses for typical x-ray examinations. The British Journal of Radiology 70: 437-439; 1997. (5,000 patient dose measurements from 375 hospitals)

2. RADAR Medical Procedure Radiation Dose Calculator, http://www.doseinfo-radar.com/RADARDoseRiskCalc.html, Accessed 23 February 2006.

3. United Nations Scientific Committee on the Effects of Atomic Radiation. Sources and effects of ionizing radiation, Vol. 1: Sources. New York, NY: United Nations Publishing; 2000.

---

* The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Since its formation in 1956, the Society has grown to approximately 6,000 scientists, physicians, engineers, lawyers, and other professionals representing academia, industry, government, national laboratories, the Department of Defense, and other organizations. Society activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. Society members are involved in understanding, evaluating, and controlling the potential risks from radiation relative to the benefits. Official position statements are prepared and adopted in accordance with standard policies and procedures of the Society. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101; phone: 703-790-1745; fax: 703-790-2672; email: HPS@BurkInc.com.