Radiation and Risk

MRI and Ultrasound Patients

Ultrasound and MRI exams use non-ionizing radiation, which is different from X-ray, CT, nuclear medicine, and fluoroscopy exams. There are no known long-term effects from these exams.

Computed Tomography (CT), X-ray, Nuclear Medicine and Fluoroscopy

Computed tomography, X-ray, nuclear medicine, and fluoroscopy exams use ionizing radiation. When deciding the appropriate exam to order, your provider weighs the benefit and risk and has determined that the benefit outweighs the risk in your situation.

While the word radiation may be intimidating, it is important to remember we are exposed to radiation at all times. Radiation occurs naturally and is around us at a background level. We receive radiation exposure from the air we breathe, the soil we walk upon, the food we eat, the water we drink, and cosmic radiation. Although we know that very high levels of radiation cause damage to our cells and DNA, the risk at low levels is less definitive. We subscribe to the ALARA principle, which states that we will keep our exposures "As Low As Reasonably Achievable" to reduce the risk to our patients as much as possible.

Depending on where you live, the background radiation may be higher or lower than other areas. For example, those who live at higher altitudes receive higher background radiation exposure from higher levels of cosmic radiation. Those who travel by air also have higher exposure to cosmic radiation. Some areas of the world have higher levels of radioactive minerals in the soil and water that are, therefore, present in the food and water they consume.

The following table lists some common exams and compares the estimated effective dose * for those exams with normal background radiation:

Activity/Exam	**Average Effective Dose (mSv)***	**Time equivalent to natural background radiation**
Average US background radiation (excluding medical)	3	1 year
Smoking 1 pack/day	0.49	59 days
Annual exposure airline personnel	2.2	9 months
Computed Tomography		
CT Head	2	8 months

CT Chest	7	2.3 years
CT Abdomen/Pelvis	10	3.3 years
CT Extremity	0.1	12 days
CT Calcium Scoring	2	8 months
CT Angiography Head	5	1.7 years
CT Angiography Heart	20	6.7 years
Plain Film X-rays		
Chest x-ray	0.08	10 days
Hands/feet	0.001	< 1 day
Abdomen	0.7	3 months
Mammogram	0.18	1 month
Lumbar spine series	1.5	6 months
Thoracic spine series	1	4 months
Cervical spine series	0.2	1 month
Skull	0.1	12 days
Pelvis	0.6	2 months
Knee	0.005	< 1 day
Shoulder	0.008	1 day
Hip	0.7	3 months
Dental bitewing/image	0.005	< 1 day
Dental panoramic	0.01	1 day
DEXA	0.001	< 1 day
Fluoroscopic Diagnostic and Interventional Procedures		
Urinary studies	2	8 months
Myelography	4	1.3 years
ERCP	4	1.3 years
Arthorograms (ortho/joint)	0.2	24 days
OB/GYN	1	4 months
Biopsy	1	4 months
Vertebroplasty	0.6	2 months
Peripheral vascular	5	1.7 years
Neurologic (incl carotid)	5	1.7 years
Renal	5	1.7 years
Pulmonary arteriogram	6	24 months
IR Vascular access	7	2.3 years
Angioplasties	5	1.6 years
Stent placement	40	13.3 years
Embolization	55	18.3 years
Cardiac arteriogram	7	2.3 years

Cardiac percutaneous intervention	23	7.7 years
Cardiac EP study	3.2	1.1 years
Pacemaker implantation	1	4 months
Nuclear Medicine Scans		
PET/CT	10	3.3 years
Neurology	6.6	2.2 years
Bone Scan	4	1.3 years
Lung Perfusion/Ventilation	2.5	10 months
Inflammation	5.9	2 years
Stress test	9.7	3.2 years
GI	2.9	1 year
Genitourinary	1.4	6 months
* Effective dose is not a measured dose. It uses tissue weighting factors and sensitivities of affected organs to estimate a dose that, if the whole body received in one uniform exposure, would result in the same biological effect.		

Sources:

1) NCRP Report No. 184- Medical Radiation Exposure of Patients in the United States (2010)
2) NCRP Report No. 160- Ionizing Radiation Exposure of the Population of the United States (2009)

Risk of Effects

There are two categories of effects of radiation exposure. Deterministic effects are effects that are predictable, that have been seen consistently, and are reproducible. Deterministic effects occur most frequently at high levels of radiation and not at the levels seen in diagnostic medical exams.

Stochastic effects are statistical effects, in that they are random and unpredictable. Low levels of radiation exposure, such as those levels in diagnostic imaging, fall into this category. There is no definite risk known at low levels, but several studies extrapolate risk from high levels to estimate a risk level.

Many references will estimate an excess risk of cancer of approximately 5% per Sievert (1000 mSv). Based on data through 2017 on www.cancer.gov, approximately 39.5% of men and women in the US will be diagnosed with cancer at some point in their lives. Theoretically, a CT abdomen/pelvis has an effective dose of about 10 mSv. Using this excess risk estimate, the excess risk of cancer from this exam may be 0.005%. That means the risk of cancer for a patient in the US could possibly increase from 39.5% to 39.505%.

What can you do to reduce your radiation exposure?

1) **Notify your provider if you are pregnant.** A fetus is very sensitive to radiation and certain times in gestation are more sensitive than others. Some imaging is safe to do with pregnant patients with specific modifications, but it is important that all providers, from your ordering provider to the imaging technologist, are aware that you are pregnant.

2) **Be your own advocate.** If you feel that an exam is unnecessary or was recently performed and does not need to be repeated, speak up. Let your provider know that you are concerned about the appropriateness of your exam. He/She should be able to explain why they have ordered a particular exam and let you know if there are other alternatives that may be just as appropriate.

3) **Keep track of your exams**. With the advent of electronic medical records (EMR), it is easier than ever for providers to keep track of all of your exams and results in one place. While the easiest way to do this is to stick with one provider network that uses the same EMR system, you can also keep a log of your exams or ask for digital/CD copies of your exams when they are complete. Each facility has different requirements for requesting copies. You will be asked to sign a release and/or official request for each exam.

Bottom Line

Diagnostic imaging typically uses very low amounts of radiation, and imaging equipment continues to improve by the day. The advances in dose reduction and image quality have increased tremendously in the last decade and continue to do so. Before imaging, the only way for a physician to see inside your body was to perform exploratory surgery. Today, the imaging options are many, and we continue to optimize our capabilities, while keeping the exposure of the patient as low as reasonably achievable. Using non-invasive or minimally-invasive imaging tools has greatly expanded the diagnostic capabilities of our medical providers. Rest assured that the staff at Community Health Network works hard to care for our patients in the safest way while providing the diagnostic tools your provider needs to provide your best care.

If you have further questions, feel free to contact our network Radiation Safety Officer Erin Bell at ebell2@eCommunity.com.

Resources:

https://www.imagewisely.org/Imaging-Modalities/Computed-Tomography/How-to-Understand-and-Communicate-Radiation-Risk

www.cancer.gov

NCRP Report No. 160- Ionizing Radiation Exposure of the Population of the United States (2009)

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