ACI NSW Agency for Clinical Innovation

Radiology Clinician Fact Sheet

Radiation Information

This fact sheet has been developed as a reference to help radiology clinicians and referrers to medical imaging services consistently explain the benefits and risks associated with imaging procedures and radiation doses to patients.

This fact sheet is not designed to be given to patients and the general public. Patients seeking further information should be provided with a copy of the *ACI Medical Imaging and You* brochure, which can be found on the ACI website.

Background Radiation in Australia

Radiation dose to humans is usually expressed in millisieverts (mSv). The radiation dose to a person in Australia from natural sources is about 2mSv per year. Medical x-ray procedures provide a measurable additional radiation dose to natural background radiation exposure.

Benefits of having a Radiology Examination

The benefit from any radiology examination is to assist the diagnosis of a medical problem or symptom or to confirm whether the patient has a disease or injury.

Diagnostic tests such as x-rays, CT scans and PET scans save lives. They enable detection of serious and potentially fatal diseases like cancer at an early stage when they can't otherwise be picked up, and when they can still be cured or controlled. These tests can also rule out serious illness, providing reassurance and peace of mind to the patient.

Risks of having a Radiology Examination

Risk is usually expressed as the probability that something is likely to happen based on observations in a large group of people.

1) Tissue reaction

The radiation dose received from simple routine x-ray examinations is a thousand times too low to produce tissue reactions such as skin reddening or hair loss. This occurs on rare occasions from very long or complex x-ray procedures using fluoroscopy or CT scanning.

2) Risk (probability) of heritable diseases (damage to offspring)

There is no direct evidence that exposure to radiation increases the risk of heritable disease in offspring[1]. However medical radiation exposure to the ovaries and testes of patients is minimised as a precaution.

3) Risk (probability) of developing cancer

At the low doses used in single radiology procedures it is unclear whether, or to what extent there is an increased risk of cancer. At moderate doses (>50mSv), increased cancer risk is likely to be proportional to dose. Radiation dose is cumulative so there may be an increase in the lifetime risk of developing cancer following multiple procedures.

Radiation Exposure

The actual dose that a patient receives varies substantially according to the type of examination. It also depends on the patient's age, gender, body size, anatomy and the x-ray equipment used. It is not possible to accurately predict the specific dose received by individual patients. In addition, each patient's sensitivity to radiation depends on their age, gender and other biological factors. The risk is lower for older people and higher for children and unborn babies, so extra care is taken to minimise the radiation dose with young or pregnant patients.

X-rays in pregnancy

It is essential to minimise the chance of x-ray exposure to a baby in the uterus because a fetus is more sensitive to radiation than an adult. The patient should have discussed with the referring doctor whether to postpone the examination, or if an ultrasound or MRI is an alternative. In a few cases, where information that can only be obtained from an x-ray is of clear benefit to the mother and baby, the examination will be done with a minimal dose to the fetus, well below the level of injury to the fetus. The examination should only proceed after approval by a Radiologist.

Approximately 1 in 500 children develops cancer during childhood even without radiation as a fetus. Whilst it is acknowledged that radiation does present a small increased risk of cancer, the International Commission on Radiological Protection (ICRP) has stated that death, slowing of normal growth, abnormal growth and being intellectually or emotionally underdeveloped would not be expected to occur in an embryo or fetus that had been exposed to less than 100 mSv of radiation.

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TABLE 1: X-RAY EXAMINATION EXPOSURE IN ADULTS

The radiation doses in this table are population averages only.
The dose to an individual may be higher or lower than these values.

Radiology examinations	Effective dose range (mSv)[3 & 4]	Equivalent exposure to natural background radiation (2 mSv per year)[3]	Equivalent to times of travel on a 7 hour flight (0.05 mSv per 7 hours flight)[1]
MRI and Ultrasound Examinations	No radiation	N/A	N/A
X-ray tooth (dental film)	~ 0.004	< 1 day	< 1 time
X-ray jaw (OPG)	~ 0.014	< 3 days	< 1 time
X-ray chest (1 image)	~ 0.02	< 4 days	< 1 time
X-ray chest (2 images)	~ 0.04	< 8 days	< 1 times
X-ray extremities / X-ray skull / X-ray cervical spine (neck)	0 to 0.1	0-18 days	< 2 times
X-ray thoracic spine (middle spine) / X-ray lumbar spine (lower back) (1 image) / X-ray abdomen / X-ray pelvis / Mammography (2 images)	0.1 to 1	18 days to 6 months	2-20 times
Barium swallow / Barium meal CT head / CT cervical spine CT chest (without portal liver phase)	1 to 5	6 months to 2.5 years	20-100 times
Angiogram-coronary / Angiogram-pulmonary / Angioplasty-coronary Barium enema / CT chest (with portal liver phase) / CT renal (KUB) / CT abdomen and/or pelvis (single image) / CT thoracic spine / CT lumbar spine	5 to 10	2.5 years to 5 years	100-200 times
Angiogram-abdominal / Aortography-abdominal / CT chest / abdomen / pelvis CT abdomen / pelvis (multiple images) CT pulmonary angiogram[5] / CT coronary angiogram[5]	> 10	> 5 years	> 200 times

TABLE 2: X-RAY EXAMINATION EXPOSURE IN PREGNANCY

An indication of the expected dose and additional risk of radiation to a fetus or embryo with various examination types.[6]

Examination Type	Typical fetal dose mSv	Risk of childhood cancer per examination
Ultrasound and MRI examinations	0	0
X-ray skull / X-ray chest / X-ray thoracic spine / Mammogram / CT head or neck	0.001-0.01	< 1 in 1,000,000
CT pulmonary angiogram / Lung ventilation scan	0.01-0.1	1 in 1,000,000 to 1 in 100,000
X-ray abdomen / pelvis / hip or barium meal / CT chest and upper abdomen Nuclear medicine scans using Technetium-99m including thyroid, lung perfusion, renal (MAG3, DMSA) or white cell scans	0.1-1.0	1 in 100,000 to 1 in 10,000
X-ray lumbar spine / Barium enema / Intravenous pyelogram or urogram CT abdomen or lumbar spine Nuclear medicine scans: - using Technetium-99m including bone and cardiac blood pool scans - Thallium-201 myocardial scan	1.0-10	1 in 10,000 to 1 in 1,000
CT pelvis or pelvis and abdomen / PET CT Technetium-99m myocardial SPECT (rest – exercise protocol)	10-50	1 in 1,000 to 1 in 200

References

1. Australian Radiation Protection and Nuclear Safety Agency, Fact Sheet, Radiation Protection, Ionising Radiation and Health, ARPANSA, 2003
2. Australian Radiation Protection and Nuclear Safety Agency, Fact Sheet, Radiation Protection, Cosmic Radiation Exposure, ARPANSA, 2010
3. Australian Radiation Protection and Nuclear Safety Agency, Radiation Protection Series No 10, Radiation Protection in Dentistry , ARPANSA , 2005
4. Australian Radiation Protection and Nuclear Safety Agency, Radiation Protection Series No 14.1, Radiation Protection in Diagnostic and Interventional Radiology, ARPANSA , 2008
5. F.A. Mettler et al. Effective Doses in Radiology and Diagnostic Nuclear Medicine: A Catalog, Radiology Vol 248, Number 1, p254-259. Radiological Society of North America, 2008
6. Royal Australian and New Zealand College of Radiologists, Inside Radiology: Radiation Risk of Medical Imaging During Pregnancy, Available URL: www.insideradiology.com.au <Accessed 2011, April> .

Useful website for further information
www.insideradiology.com.au

Agency for Clinical Innovation website
www.aci.health.nsw.gov.au

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