Radiation Protection and Safety

Radiology SSU Workbook

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Overview

- Interesting facts
- A little bit of basic physics
- Radiation and cell damage
- Effects and relative risk of radiation exposure
- Making the right choices for your patient
- Safety in a radiology department

A little bit of basic physics.....

- X-Rays are created using an x-ray tube
- They leave the tube heading towards the patient in a beam
- They pass through the patient
- Some x-rays will be absorbed by the patient
- Some will pass straight through
- The x-rays are detected and a black and white image is formed

Why does radiation protection matter?

- When x-rays travel through the body they collide with atoms
- Collision leads to ionisation
- Ionization of cells causes inherent damage
  - Indirect cell damage by free radical formation
  - Direct cell damage by molecular change
- Damage may be temporary or permanent
- Rapidly dividing cells are more susceptible

Have a go… Question 1

Put these organs in an order of how susceptible they are to radiation;

Stomach, bone, testes, lung, brain, skin, breast

Why does radiation protection matter?

- Dose dependant biological effects;
  - Skin erythema, permanent skin damage, hair loss, sterility.
- Other biological effects, such as development of cancer, are random.
- Radiation exposure to reproductive organs carries further potential risk to future generations.
- Children are more radiosensitive than adults and irradiation of a fetus should be avoided wherever possible.
- The fetus is most at risk in the 3-8th week of pregnancy, damage may be sufficient to cause spontaneous abortion, or induce birth defects.

Dose in perspective[1]

Source of Exposure	Dose
135g bag of Brazil nuts	0.005 mSv
Chest X-ray	**0.02 mSv**
Transatlantic flight	0.07 mSv
CT scan of the head	**1.4 mSv**
UK average annual radiation dose	2.7 mSv
CT scan of the chest	**6.6 mSv**
Average annual radon dose to people in Cornwall	7.8 mSv
Whole body CT scan	**10 mSv**
Level at which changes in blood cells can be readily observed	100 mSv
Acute radiation effects including nausea and a reduction in white blood cell count	1000 mSv
Dose of radiation which would kill about half of those receiving it in a month	5000 mSv

Test Yourself…..Question 2:

By how many times is a CT chest dose higher than a plain chest X-ray?

Ordering Tests Involving Radiation

- What do I want to know?
- Is there an alternative test without radiation?
- Is my patient pregnant?
- **If you are in doubt about justifying a procedure or investigation you should discuss it with a radiologist.**

Tests with Radiation

- X-Rays
- Fluoroscopy – e.g. Barium Enema
- CT
- Image intensifier in theatre

Test Yourself....Question 3:

17 year old female patient with RIF pain
? Appendicitis ? Ovarian Cyst
bHCG –ve

What would be the most appropriate imaging to order?

Tests without Radiation

- Ultrasound
- MRI

Safety in the department

- Staff are at potential risk from radiation exposure.
- The doses that radiologists and radiographers are exposed to are generally small.
- Radiation exposure, no matter how small, carries some risk.
- Local rules are enforced to ensure that dosimetry badges and protective clothing such as lead aprons are worn, in order to monitor and reduce staff radiation dose.
- Knowledge of the 'inverse square law' helps in reducing dose. This states that the dose to a given area is quadrupled by halving the distance from the radiation source. Simply put, standing back from a source of radiation reduces dose to staff. This is particularly important during interventional radiology cases where staff are working close to the X-ray beam.

A few safety tips in the department....

- Be aware of your surroundings....
- Make sure you check the lit signs before you enter a room
- Keep an eye on everyone around you, use them as a guide for what you should be doing
- If everyone is wearing leads ask if you should be as well
- Don’t be afraid to ask questions, it’s not always easy to know where you can stand or what you should do

References

1. http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/UnderstandingRadiationTopics/DoseComparisonsForIonisingRadiation/