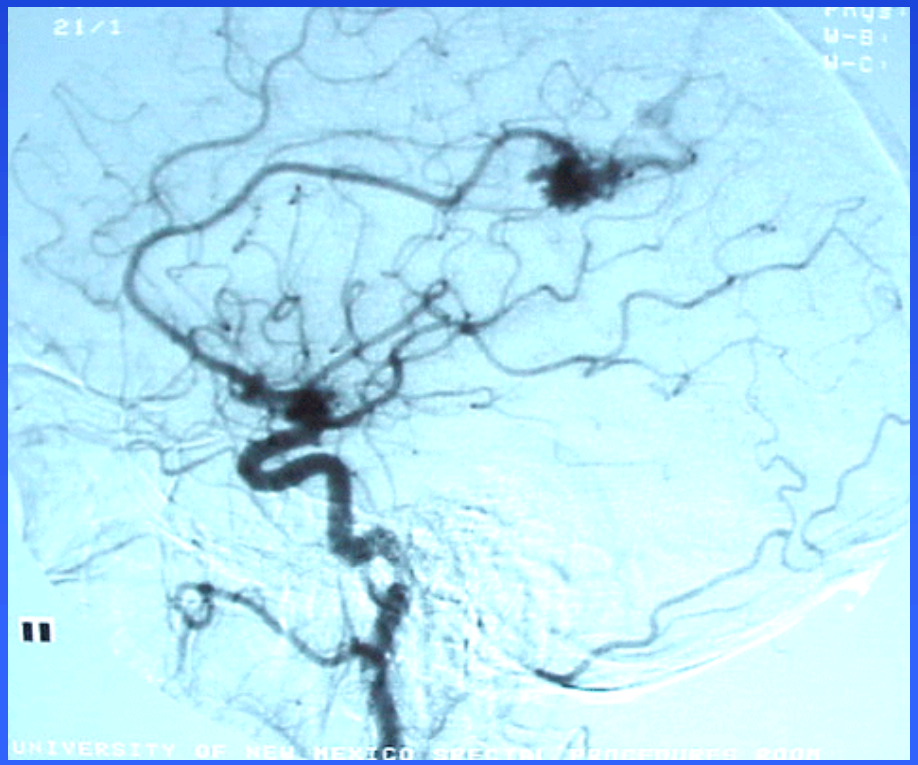
Interventional Procedures – Avoiding Radiation Injuries



International Commission on Radiological Protection

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Available at **www.icrp.org**

Task Group: J. Cardella, K. Faulkner, J. Hopewell,
H. Nakamura, M. Rehani, M. Rosenstein, C. Sharp,
T. Shope, E. Vano, B. Worgul, M. Wucherer

Use and disclaimer

- This is a PowerPoint file
- It may be downloaded free of charge
- It is intended for teaching and not for commercial purposes
- This slide set is intended to be used with the complete text provided in ICRP *Publication 85*

Background…

- Interventional techniques using radiation are now practised by clinicians of many specialities
- Most clinicians are unaware of the potential for radiation injury

Background (cont'd)

- Patients are often not informed of radiation risks
- Staff may also be exposed to high doses
- Techniques are available to reduce doses to patients and staff

Chronic radiodermatitis in 17 year old female patient after x2 radiofrequency ablation procedures

Hyper & hypo pigmentation, with telangiectasia

Atrophic indurated plaque

Introduction

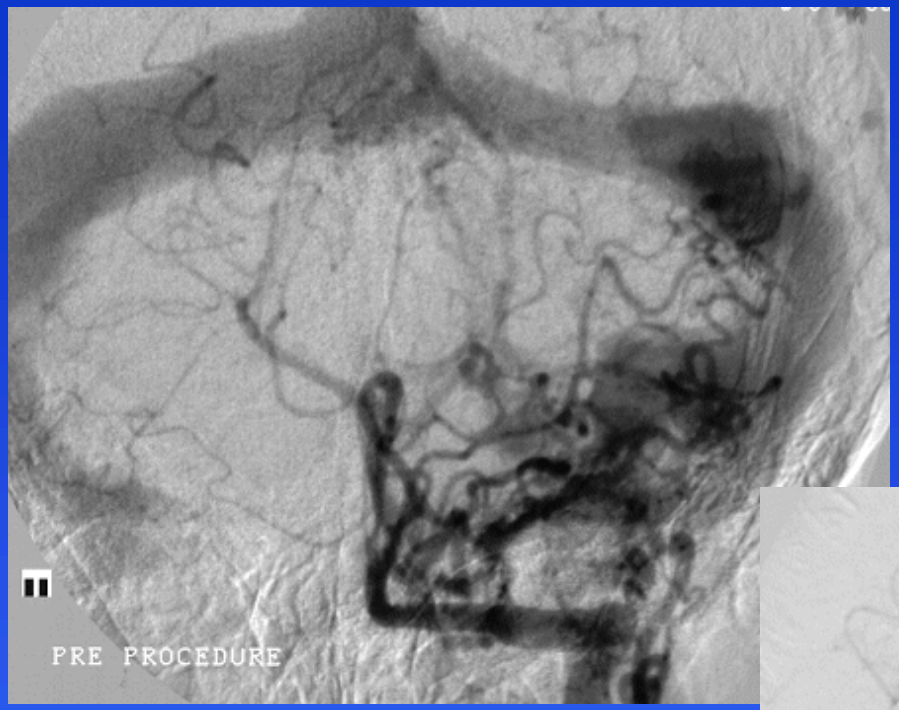
- Many interventional procedures are performed by clinicians largely untrained in radiation effects and safety – some patients & staff have suffered unnecessary injuries
- Most patients are not counselled on radiation risks nor followed up appropriately to detect injury
- Doses to patients and staff can often be reduced without compromising clinical outcome

Medical radiation procedures

- All procedures involving radiation should be justified (more benefit than risk)
- Medical exposures should also be justified on an individual basis before being performed
- Once justified, the actual procedure and dose should be tailored to the individual patient

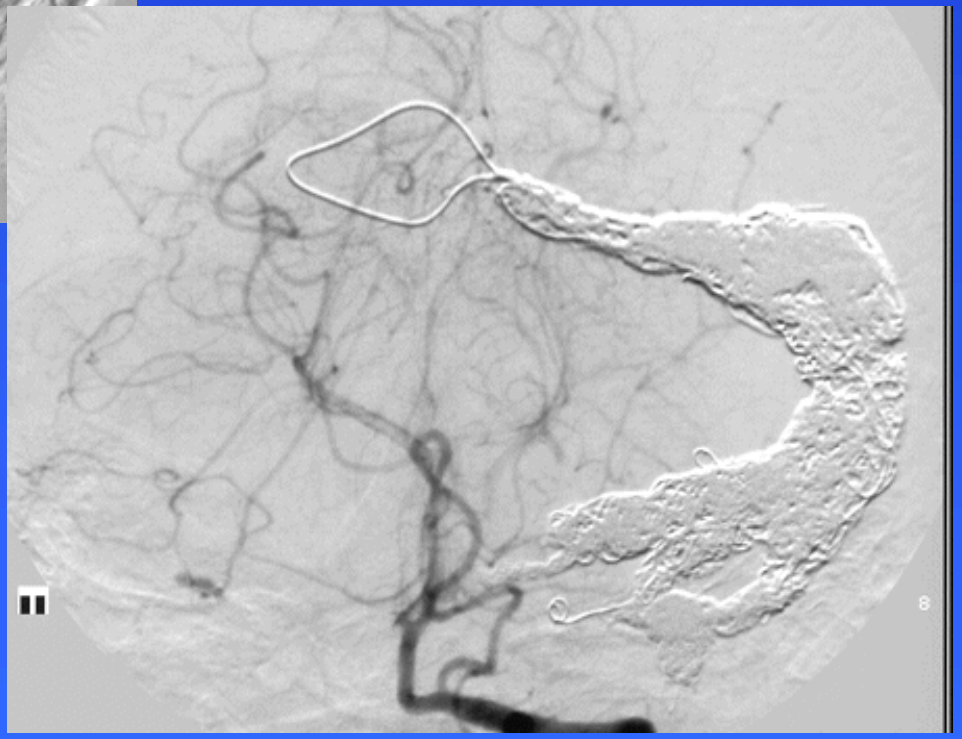
Interventional procedures doses

- In some procedures, patient skin doses approach those used in radiotherapy fractions
- In young patients, organ doses may significantly increase the risk of radiation-induced cancer in later life



17 years female - large dural fistula of left lateral sinus

Neuroradiological procedures may be complex and long



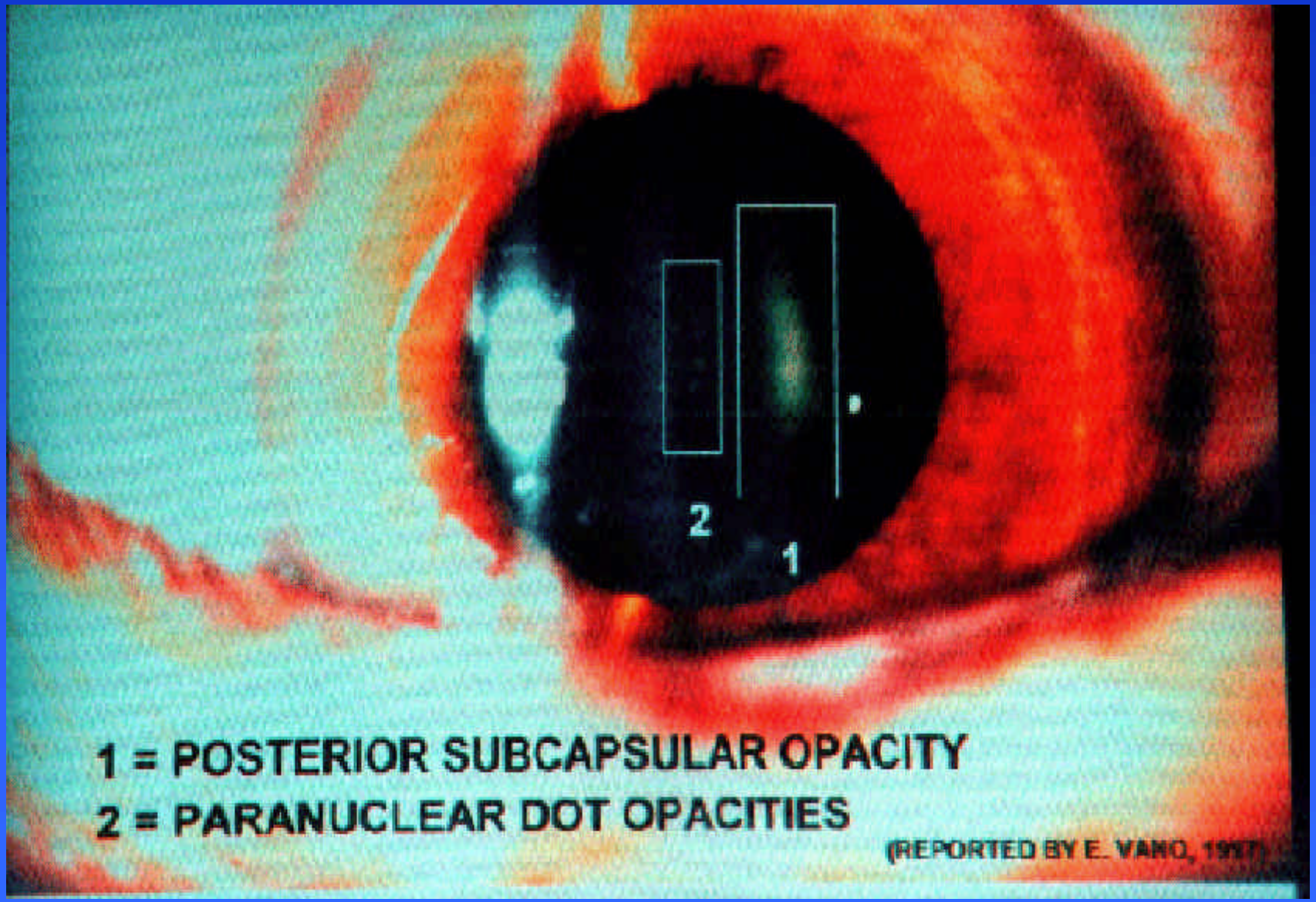
Post embolisation

Images courtesy of Dr JN Higgins

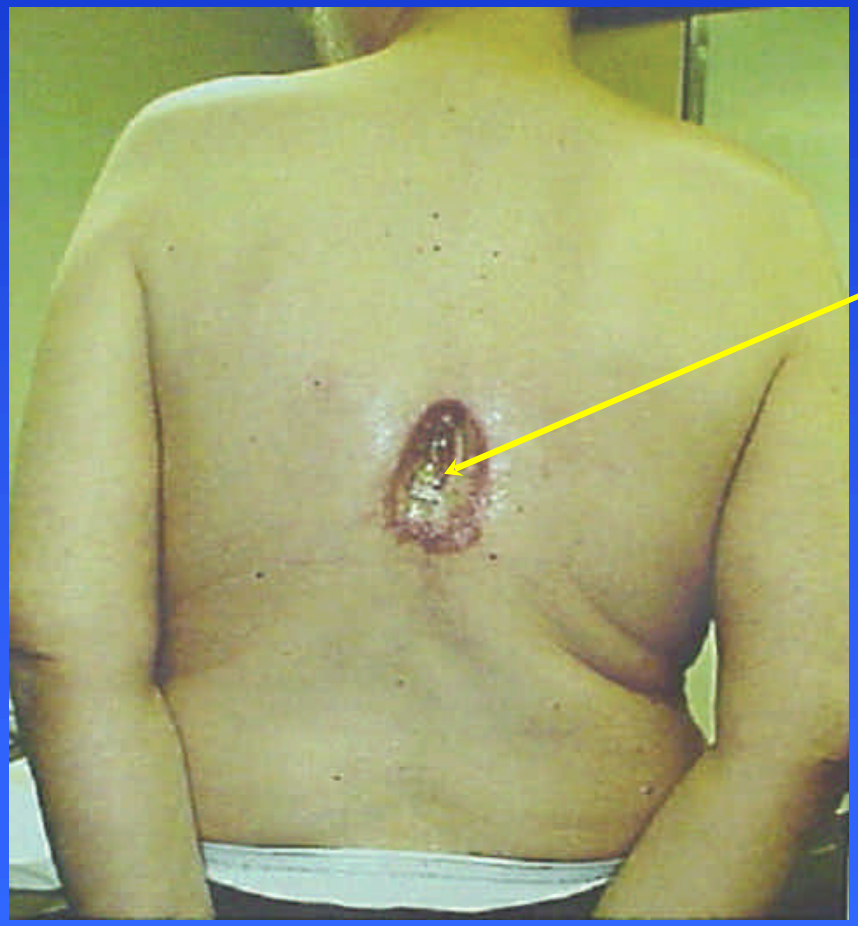
Interventional procedures doses

- Higher doses are often due to inappropriate equipment or poor technique
- Irradiation of the eye can cause cataract

Cataract in eye of interventionist after repeated use of over table x-ray tube



Example of chronic skin injury due to cumulative skin dose of ~20,000 mGy (20 Gy) from coronary angiography and x2 angioplasties

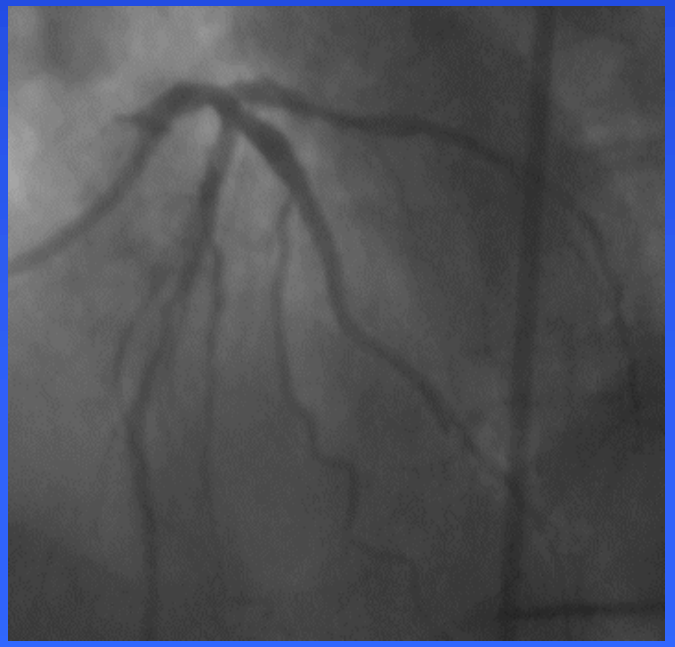


21 months afte
first procedure
base of ulcer
exposes spinou
process

Patient age 60. Tight stenosis of obtuse marginal artery on coronary angiography

Technically difficult procedure – lengthy screening

Following angioplasty and stent insertion



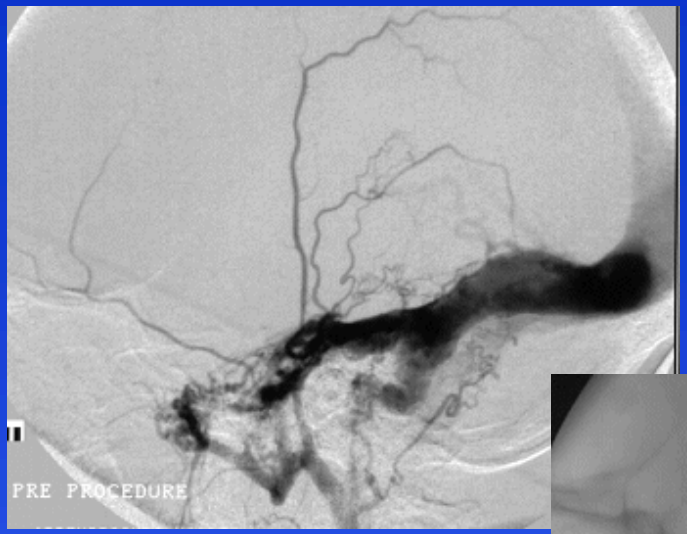
Doses in interventional procedures

Effect	Threshold dose (Gy)	Minutes fluoro at 0.02 Gy/min	Minutes fluoro at 0.2 Gy/min
Transient erythema	**2**	**100**	**10**
Permanent epilation	**7**	**350**	**35**
Dry desquamation	**14**	**700**	**70**
Dermal necrosis	**18**	**900**	**90**
Telangiectasia	**10**	**500**	**50**
Cataract	**>5**	**>250 to eye**	**>25 to eye**
Skin cancer	**Not known**	**Not known**	**Not known**

Interventional procedures

REMEMBER:

- **Even a straightforward procedure can become high-dose with poor technique**
- However, even with good technique – adverse effects occur



17 years female. Left dural fistula pre and post embolisation - multiple procedures

Fluoroscopy time over 19 hours in one year

Lengthy and repeated procedures may be unavoidable

2 episodes hair loss - both recovered

Images courtesy of Dr JN Higgins

Controlling dose to patients…

- Keep beam-on time to a minimum
- Dose rates will be greater and dose accumulates faster in larger patients
- Keep tube current as low as possible and tube potential (kVp) as high as possible
- Keep x-ray tube at maximum and the image intensifier at minimum distance from patient

Controlling dose to patients (cont'd)

- Always collimate closely to the area of interest
- Prolonged procedures: reduce dose to the irradiated skin e.g. by changing beam angulation
- Minimise: fluoro time, high dose rate time & number of acquisitions
- Don't over-use geometric magnification
- Remove grid for small patients or when image intensifier cannot be placed close to patient

Controlling dose to staff

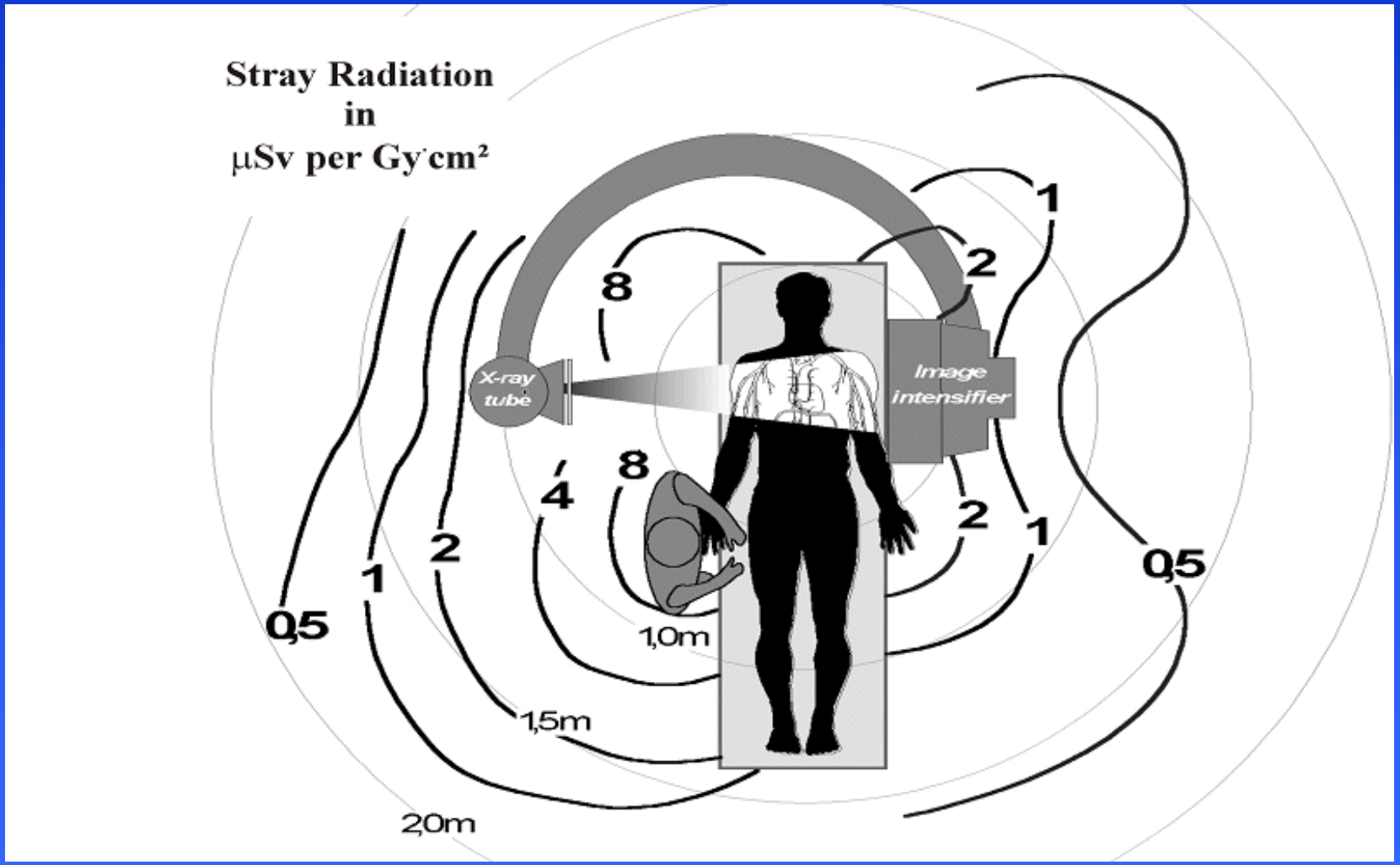
REMEMBER:

Controlling dose to patient will help control dose to staff

Controlling dose to staff

- Wear protective apron & glasses, use shielding, monitor doses – hand dose is often important
- Correct positioning to machine to minimise dose
- If beam horizontal (or near to) operator should stand on image intensifier side, if possible
- If beam vertical (or near to) keep the tube under the patient

Plan view of an interventional operating x-ray unit with isodose curves



In high dose mode – dose rates will be mSv/hr (same numerical values)

Other factors in controlling dose

- Ensure all staff are appropriately trained
- Use dedicated interventional equipment with correct specification
- Ensure comprehensive maintenance and quality assurance programmes are in place
- Obtain advice from a qualified radiation expert

Informed consent and records

- Patients are entitled to know the risks of radiation injury if likely to be high
- A written record should be kept if skin doses are estimated to be >3 Gy (1 Gy for repeated procedures)
- Not all skin reactions are due to radiation; e.g. contrast medium allergy

Follow-up

- Radiation skin injury may present late and the association not considered if no documentation
- All patients with estimated skin doses of 3 Gy should be followed up 10-14 days after exposure
- A system to identify repeat procedures should be set up

Leukaemia and cancer

- Most interventional procedures are performed on older patients where benefit almost always outweighs radiation risk
- The radiation risk increases progressively with younger age groups
- Radiation has been shown to increase the risk for leukaemia and many types of cancer in adults and children

Summary

- The radiation risk is usually outweighed by the benefit of the procedure
- Both patients and staff are at risk of radiation injury
- Appropriate equipment and training are needed to minimise this risk
- Patient counselling should be undertaken routinely, and follow up when appropriate

Web sites for additional information on radiation sources and effects

European Commission (radiological protection pages):
europa.eu.int/comm/environment/radprot

International Atomic Energy Agency:
www.iaea.org

International Commission on Radiological Protection:
www.icrp.org

United Nations Scientific Committee on the Effects of Atomic Radiation:
www.unscear.org

World Health Organization:
www.who.int