

Radiation Protection in Interventional Radiology: A necessity for interventional radiologists

Dr. Claire Cousins



Consultant Vascular & Interventional Radiologist
Addenbrooke's Hospital, Cambridge UK &
Chair of ICRP Committee 3

Interventional procedures

- Once performed by interventional radiologists
- Now performed by many medical specialists
- Little or no radiology training
- Cardiologists
- Gastroenterologists
- Urologists
- Vascular surgeons
- Etc, etc.....

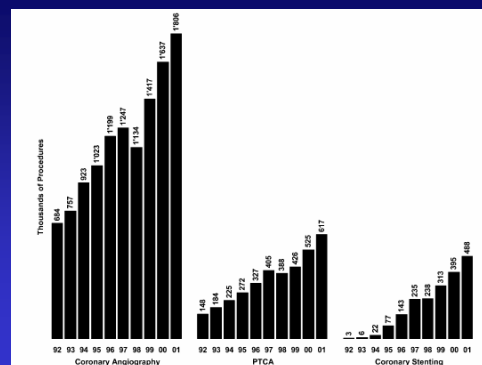


So should the title be.....

**Radiation Protection: A necessity
for all those performing
interventional procedures using
ionizing radiation**

Coronary interventional procedures

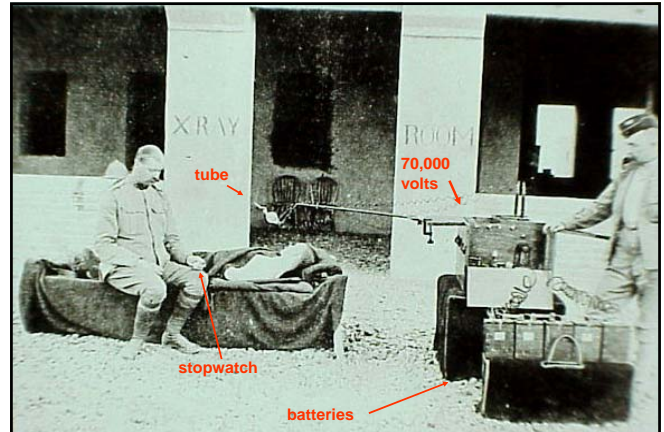
Togni et al, EHJ, 2004



Interventional procedures

Why is radiation protection important?

Because protecting the patient will also help protect the interventionalist and other staff



Interventional procedures

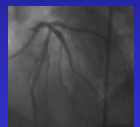
Why is radiation protection overlooked?

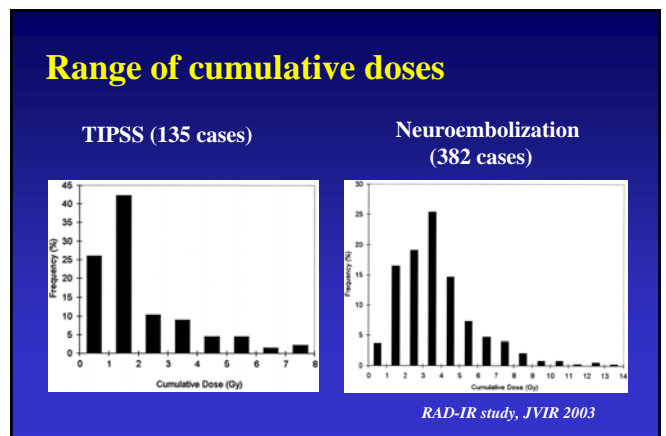
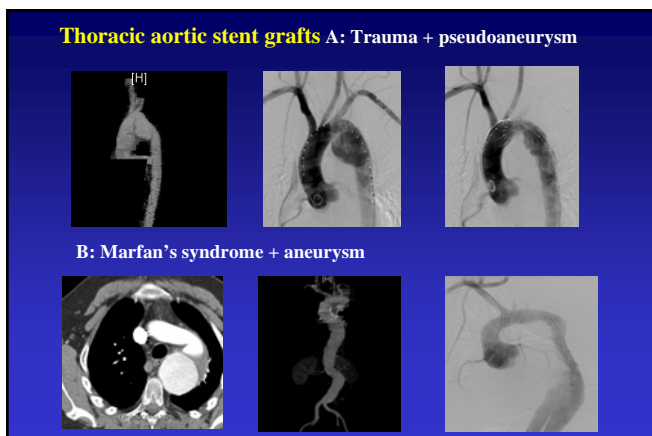
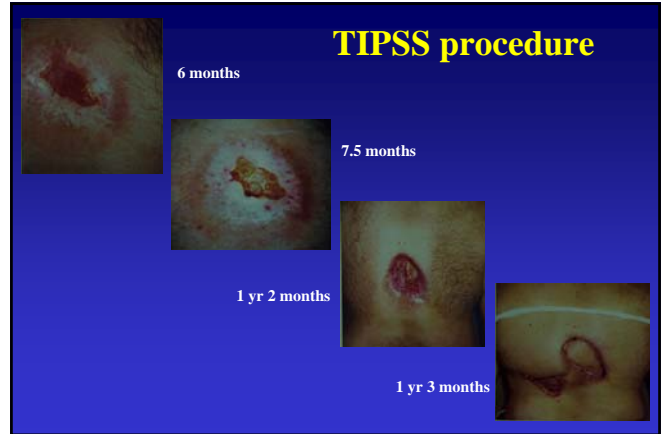
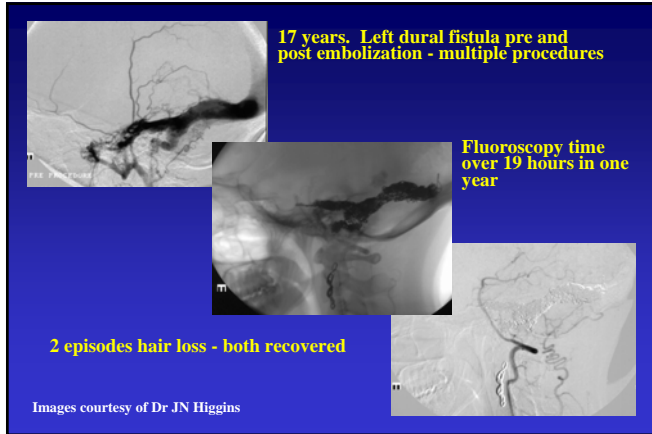
Because:

- The interventionalist has insufficient training
- The patient has no immediate radiation effect
- The operator may not see the patient again
- Radiation effects attributed to other causes

High dose procedures

- Coronary angioplasty +/-stent (3 Gy)
- Radiofrequency cardiac catheter ablation (2.5 Gy)
- Cerebral embolisation (4 Gy)
- Transjugular intrahepatic portosystemic shunt (TIPSS) (2 Gy)
- Complex aortic stent grafts (< 3.0 Gy)





Interventional procedures

REMEMBER

Even a straightforward procedure can become high dose with poor technique

BUT

Adverse effects can occur even with good technique

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

Magnitude of various factors on patient and staff dose

Patient size	up to 12 x
Image intensifier position	~ 2 x
Tube angulation	5-10 x
Tube-skin distance	up to 10 x
Magnification	factor of 1.5-3
High dose mode fluoro	up to 5 x
Std fluoro vs. cine	~ 10x
Time/Operator experience	Direct correlation. 2-3 x variation common

Typical cardiology case

- 2 previous PTCA's
- Obese patient
- Further PTCA
- 51.4 mins fluoro time
- High dose fluoro mode
- Oblique projection
- Biplane cine performed
- Painful square rash R lower back **6 wks later**



Overheated x-ray tube stopped cardiac procedure



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

Why interventionalists miss the injuries ?

- Erythema takes hours-days to occur
- Desquamation takes days-weeks to occur
- Necrosis takes weeks-months to occur
- Inspecting the back of the patient at these times is important or the injury will be missed

Ways to minimize skin dose

- Keep foot off fluoroscopy pedal
- Avoid high intensity mode
- Adjust beam position
- Safe to stop procedure – consult colleague
- Minimize gap between intensifier & patient
- Maximize distance between source & patient
- Use largest practical field of view
- Don't irradiate arms and breast
- Use a skin dose monitor or a DAP meter

Wagner 2002



9 mths post PCI



22 mths post PCI

Informed consent & 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

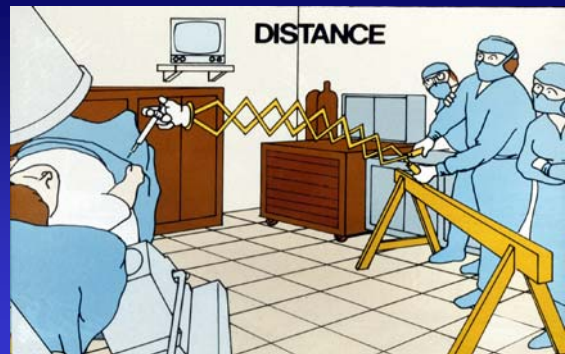
ICRP Pub 85

High radiation risk

- Occupational doses in interventional procedures are the highest registered among medical staff using x-rays
- Radiation lesions may result after several years of work if:
- Protection tools and good operational measures are not used
- Several complex procedures are undertaken per day

Controlling dose to staff

- Wear protective apron & glasses, use shielding, monitor doses – hand dose is often important
- Correct positioning of 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



Staff protection measures

- Lead coat
- Thyroid shield
- Lead glasses
- Monitors
- Also available:
Lead gloves, cap, bra,
leggings



Protection has to be practical



Thyroid protection

- Wearing a thyroid collar does not prevent thyroid cancer
- But this happens in children
- **NOT** seen in adults. Pooled analysis by NCI showed no detectable risk from external radiation after age 20 at exposure

Cataract and radiation

- Previously thought to be a threshold of about 10Gy chronic radiation
- Now with good equipment opacifications can be seen at lower doses ? Maybe even with multiple CT scans
- Lead glasses do not prevent cataract but reduce dose by 95% in direct beam (125 kVp)



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

Reports of radiation related lens changes and
posterior subcapsular cataract in interventional
radiologists

Haskal RSNA 2004 unpublished



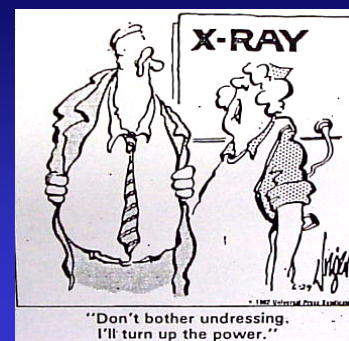
Education and Training

- Very important
- Often inadequate
- Specific training additional to that for
general radiology
- Recommended 20 - 30 hours
- Difficult to implement
- Resources – human, financial

Conclusions

- Interventional procedures rapidly increasing
- Many different specialists
- Radiation protection essential
- Increase awareness of radiation injury
through..
- Education and training

Promoting good practice....



Helps prevent injury



"I'll have to X-ray your arm again.
This one is overexposed."