How «do's» and «don'ts» can be of significant importance in radiation protection

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Purpose

The risk for deterministic effects can be a problem in interventional radiology, especially when the procedures are performed outside a Radiology department. Cardiological departments often perform advanced interventional procedures, but the competence and attitudes towards radiation protection can sometimes be absent. The International Atomic Energy Agency has recently highlighted the importance of radiation protection and competence in Cardiology [1].

A Cardiological department reported a suspicious radiation burn on a patient treated with bi-ventricular pacemaker implant (BVI), to the Norwegian Radiation Protection Authority (NRPA). The lesion was later diagnosed as radiation dermatitis. There were no dose measuring device on the X-ray equipment, but a local assessment estimated the skin dose to 9 Gy. An assessment of patient doses was initiated by the NRPA to reveal dose levels in the department and the reason for them.

Material and methods

- TLD measurements on eight patients
- On-site observations during one procedure
- Education in radiation protection
- Follow up TLD measurements on six patients after education

Results

The average maximum skin dose for eight subsequent patients was 5.3 Gy, ranging from 2.0 to 13.1 Gy (table 1). Based on these high doses, a site audit was performed to observe the working technique and general skills in radiation protection.

Observations during site-visit:

Equipment

- Siemens Multiscope (1989)
  - Image intensifier of 40 cm diameter
  - No options for pulsed fluoroscopy or last image hold
  - Option for extra filtering of the beam, but the option was not used

Not suited for cardiological procedures

Working technique

- Dose rate were not adjusted during procedure
- Image acquisition was started at the same time as the contrast injector
- Overuse of fluoroscopy was observed

Poor working technique

After the procedure a short educational summary was given, highlighting the following «Do's» and «Don'ts»:

1. **Don't overuse the fluoroscopy**
2. **Do adjust the image quality to the actual needs during the different steps in the procedure**
3. **Don't start the image acquisition before the contrast medium has reached the heart**

After this, new sets of TLD's were distributed and dose measurements were performed on six new patients. The average maximum skin dose were now 0.4 Gy, ranging from 0.2 to 0.8 Gy, less than 10% of the previous average. The average fluoroscopy time was also lowered from 48 to 24 minutes.

Discussion

The initial eight measured patient doses were all above the threshold for deterministic effects. The threshold for an early transient erythema is about 2 Gy and the patient with the highest dose, which was 13.1 Gy, was above the threshold for severe effects like dermal atrophy and teleangiectasis [2]. After the sight-visit and the educational meeting, where the **«Do's»** and **«Don'ts»** were given, all the six monitored patients were far below the threshold for deterministic effects.

Main factors for dose decrease:

- 50% reduction in fluoroscopy time
- Starting the image acquisition when the contrast media reaches the heart
- Adjusting the image quality to the actual needs during the different steps in the BVP procedure.

Conclusions

- This case shows that a few very basic advices can give significant results in dose reduction, especially if the user has no competence in radiation protection.
- The measured high doses initially motivated also probably to a change of attitudes towards radiation protection of the patients.
- To fully optimize the procedure, with respect to patient doses, much more effort has to be put in the education of the operator.
- Good working technique can overcome not optimized equipment

Patient	Fluoroscopy time [min]	Max skin dose [Gy]
1	27.0	3.64
2	77.3	4.42
3	18.1	3.03
4	60.4	2.03
5	24.2	3.03
6	22.4	9.12
7	101.0	13.14
8	52.2	4.23
Average	47.8	5.33

Table 1: Initial measurements of maximum skin dose on eight subsequent patients.

Patient	Fluoroscopy time [min]	Max skin dose [Gy]
9	32.0	0.28
10	19.5	0.68
11	18.9	0.35
12	47.0	0.75
13	13.7	0.24
14	11.0	0.36
Average	23.7	0.44

Table 2: Measurements of maximum skin dose on six subsequent patients after the education.

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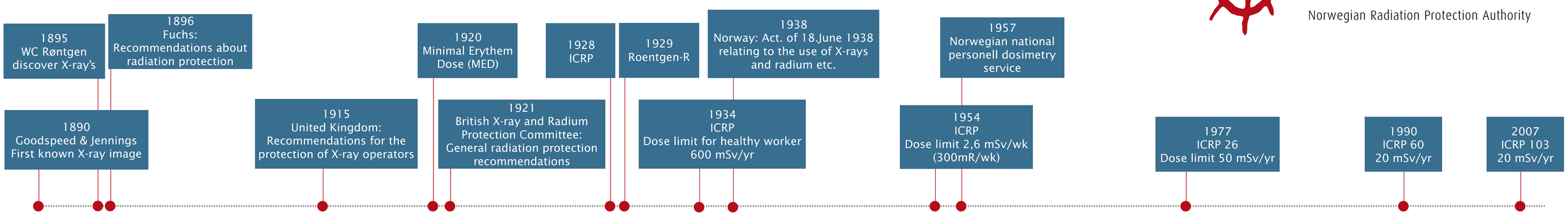

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