

Ask EuroSafe Imaging Tips & Tricks

IR Working Group

How to reduce the dose in Paediatric Interventional Radiology

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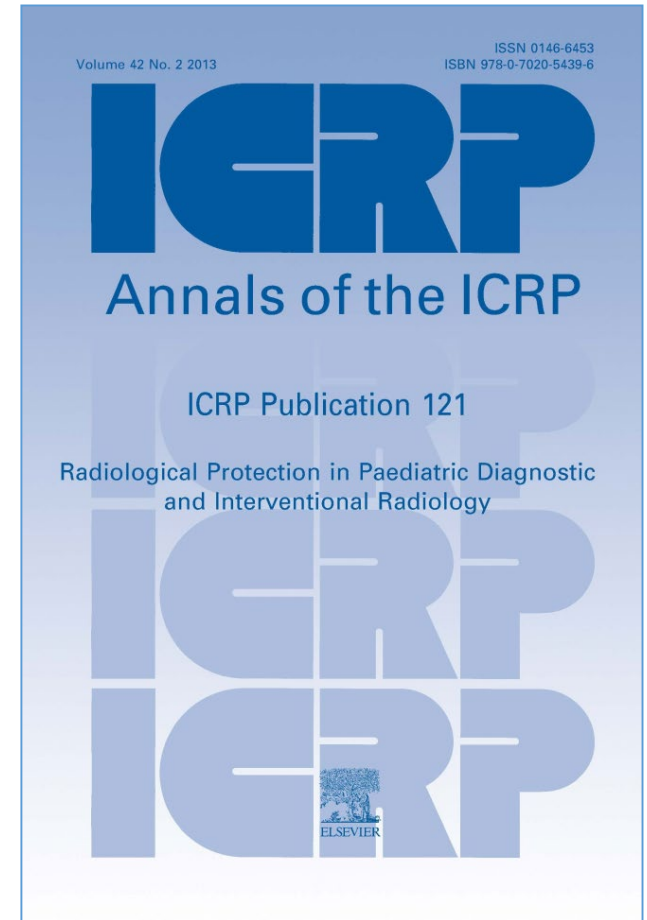
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Pediatric Interventional Radiology

- Specializes in minimally invasive diagnostic or interventional procedures using imaging guidance
- Interventional procedures in children:
 - should be absolutely justified
 - radiation exposure in young children must be lower than in adults

- Radiological procedures carry higher risk **per unit of radiation dose**, on average, for the development of cancer in infants and children compared to adults.

- The higher risk is explained by:
 - the **longer life expectancy** in children,
 - the fact that **developing organs and tissues are more sensitive** to the harmful effects of radiation.
- The average risk is **higher in infants and young children** compared with older children.



Importance of Imaging



- Pre-procedural Imaging Modality that does not require use of ionizing radiation should be preferred
 - Ultrasound
 - MRI (MRA)
- For intervention
 - Whenever possible, prefer Ultrasound guidance
 - In vascular access and various drainage procedures, fluoroscopy time should be kept to a necessary minimum

Sedation of the Pediatric IR Patient

- Good and well controlled sedation or general anesthesia should be a routine for
 - pain and anxiety management

AND

- dose management
- A well controlled, relaxed patient requires less fluoroscopy and less retakes during DSA runs

Pediatric settings and protocols

- Appropriate pediatric settings and protocols should be considered throughout the equipment work cycle
 - also at the time of purchase and equipment setup
 - as well as during ongoing IR staff education.
- DICOM standardization will make radiation dose information archival universal
 - it is important to assure that relevant information (e.g., DAP or estimated skin entry dose) be reported in the medical record
 - and considered during the informed consent process

Equipment

- It is vital to the success of any pediatric interventional service to have high-quality imaging equipment
 - (pulsed fluoroscopy, DSA, Cone beam CT) and sufficient space for the equipment
- A single pediatric interventional suite should have a digital angiographic unit (single or biplane) and a high-quality US unit
- Evidence-based quality assurance can be best achieved through multi-institutional studies, registries and collaboration

Possible radiation effects



Arm of 7-year-old patient after cardiological ablation procedure. Injury to arm occurred due to added attenuation of beam by presence of arm and due to close proximity of arm to the source.

Vano E, et al. Br J Radiol 1998; 71(845):510-6

Diagnostic Reference Levels (DRLs)



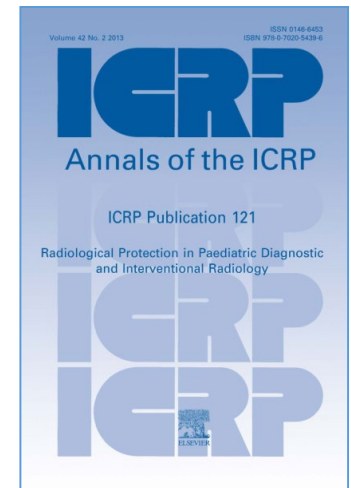
- Use the DRL's to manage paediatric radiation doses
 - Represent the typical doses delivered for a specific clinical task
 - Help you to check if patient's doses are too high or too low
 - Compare your patients median dose with the DRL
 - But Do NOT compare DRLs with single patient
 - particular patient may have a specific clinical complexity that could require higher doses than the average



<http://www.eurosafeimaging.org/pidrl>

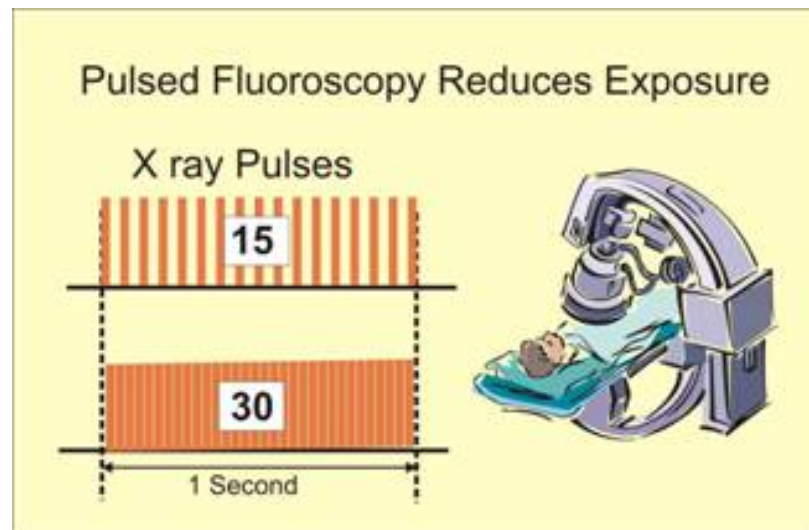
Radiological Equipment

- Adequacy for pediatrics at procurement, installation and commissioning
- Careful justification
- Experienced pediatric interventionists
- Special consideration to availability of dose reduction methods
 - virtual collimation,
 - removable grids,
 - low dose imaging modes,
 - appropriate AEC, etc



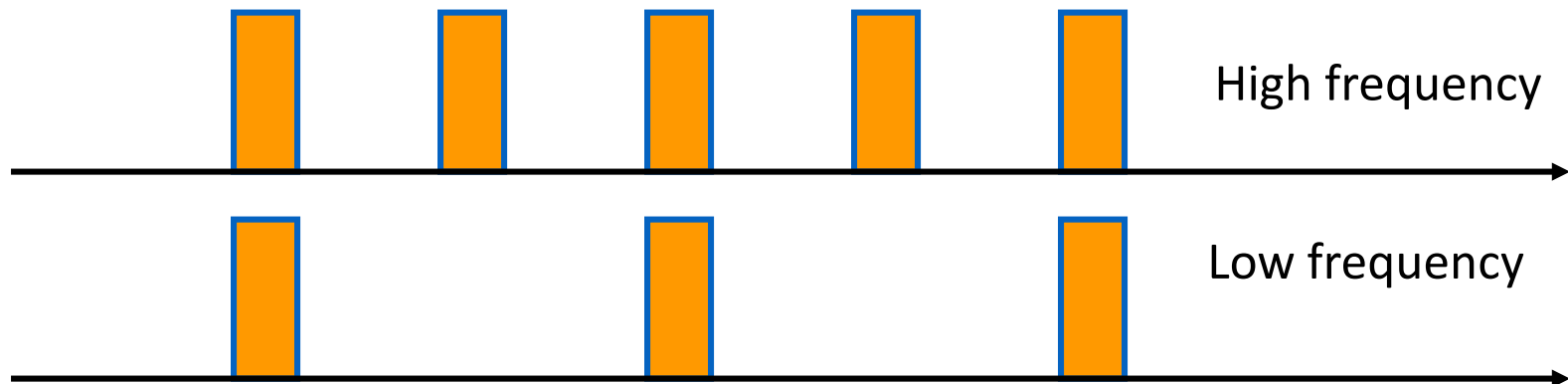
Pulsed Fluoroscopy

- Pulse length (5-20 ms) for adults reduced to 2-10 ms for children
- Pulsed fluoroscopy, as low as 3 frames/sec, allows significant patient dose reduction



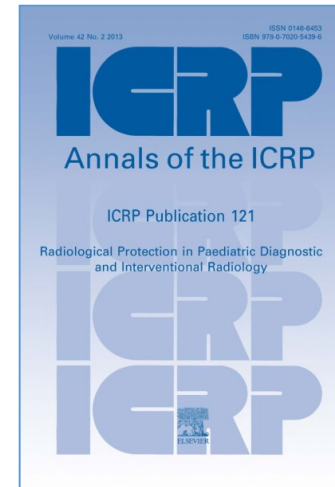
Pulsed Fluoroscopy

- Can be used as a method of reducing radiation dose, particularly when the pulse rate is reduced.
- ...but ... pulsed fluoroscopy does not mean that dose rate is lower in comparison with continuous fluoroscopy!!.
- Dose rate depends on the dose per pulse and the number of pulses per second.



Radiological Equipment

- Patient positioning and immobilization
- Shielding for breasts, gonads, and/or thyroid
 - (< 5 cm from primary beam)
 - Whenever possible without impairing the necessary diagnostic information



Summary

- There is an increased radiation risk for pediatric patients
- Number of pediatric interventions is increasing
- Radiation doses to children can be high and overall patient safety is vital
- The goal is to minimize the dose to the patient while providing good medical care
- Radiological technique must be optimized and tailored to small body sizes
- Operators shall be trained in paediatric interventions

References:

- ICRP. Radiation and your patient: a guide for medical practitioners. A web module produced by Committee 3 of the ICRP. http://www.icrp.org/docs/Rad_for_GP_for_web.pdf.
- Khong PL, et al. ICRP publication 121: Radiological protection in paediatric diagnostic and interventional radiology. Ann ICRP. 2013; 42(2):1-13.
- Connolly, B., Racadio, J., Towbin, R., 2006. Practice of ALARA in the pediatric interventional suite. Pediatr. Radiol. 36 (Suppl. 14), 163–167.
- ICRP, 2001a. Avoidance of radiation injuries from medical interventional procedures. ICRP Publication 85. Ann. ICRP 30(2).
- Bartal G., Vano E. Pediatric Radiation protection: keep the kids safe - intervene gently. CIRSE 2016 Workshop (WS 605) September 10, 2016; 16:15 - 17:15