



Implications in medical imaging of the new ICRP thresholds for tissue reactions

E. Vano, D.L. Miller and L. Dauer

Abu Dhabi

22 October 2013



New ICRP thresholds for tissue reactions

- The ICRP Statement on Tissue Reactions issued by the Commission in April 2011 reviewed epidemiological evidence and suggested that there are **some tissue reactions where threshold doses are or might be lower** than those previously considered.
- For **the lens of the eye**, the threshold is now considered to be **0.5 Gy**. The absorbed dose threshold for **circulatory disease in the heart and brain may be as low as 0.5 Gy**.

Implications in medical imaging

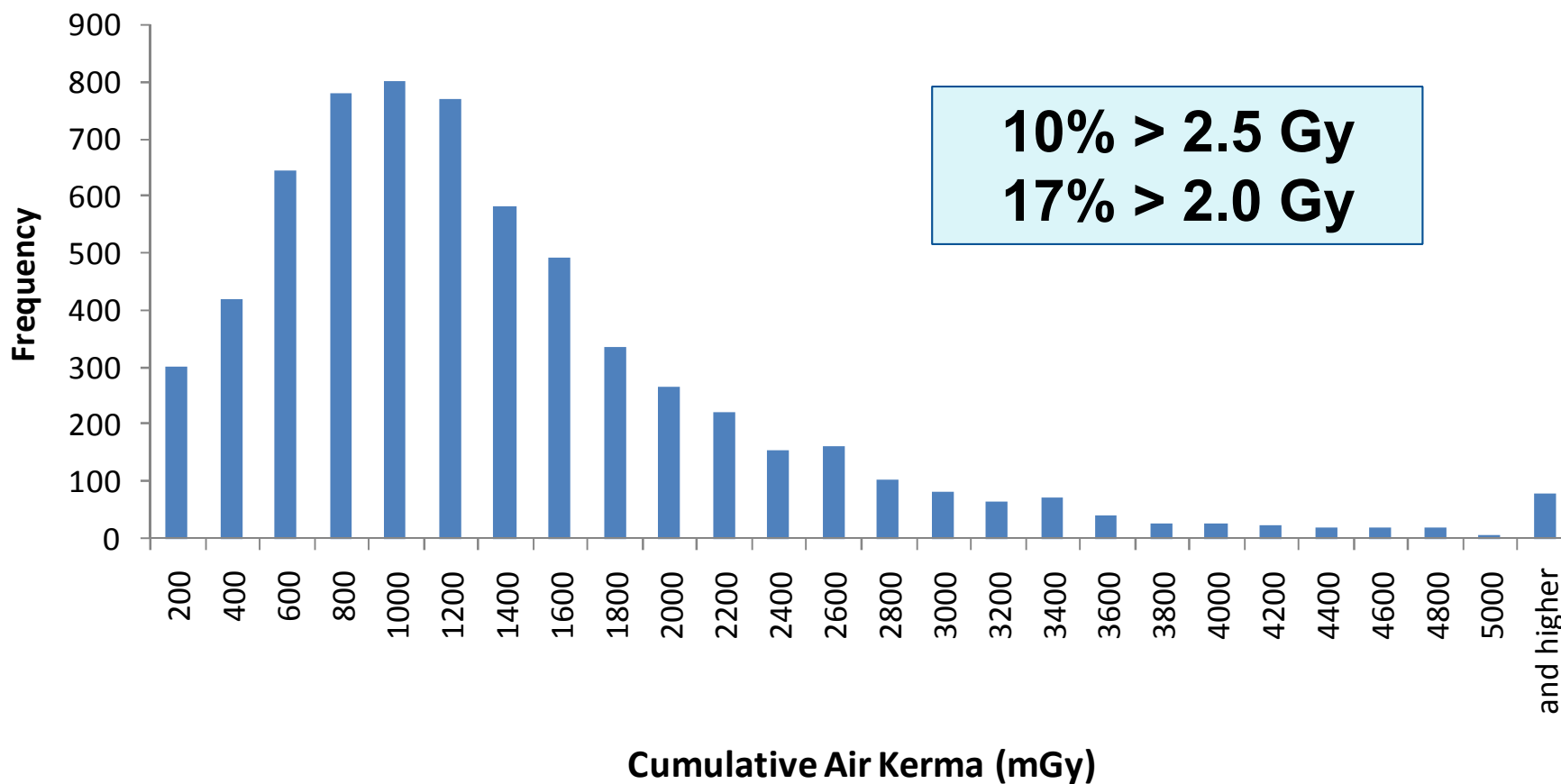
- These values may be reached in some patients (and staff) during **interventional cardiology or neuroradiology** procedures.
- The new thresholds should be considered during the **justification process and in optimization strategies for clinical procedures, especially in patients likely to require repeated interventions.**

Organ dose calculations in cardiac and neuro interventional procedures

In some of these procedures
incident air dose may be several Gy

In interventional cardiology procedures, the heart dose can be estimated as approximately 20-25% of the cumulative entrance air kerma (CAK)
CAK > 2.0-2.5 Gy implies a heart dose > 0.5 Gy

All cardiac procedures (SCUH 2010-2011)



Sample	Median	Mean	SD	Min	Max	3rd quartile
6557	1079	1325	1039	1	12683	1662

Therapeutic procedures only CAK (mGy), SCUH Madrid

Sample	Median	Mean	SD	Min	Max	3rd quartile
4128	1435	1673	1140	1000	12683	2076

16% > 2.5 Gy
27% > 2.0 Gy

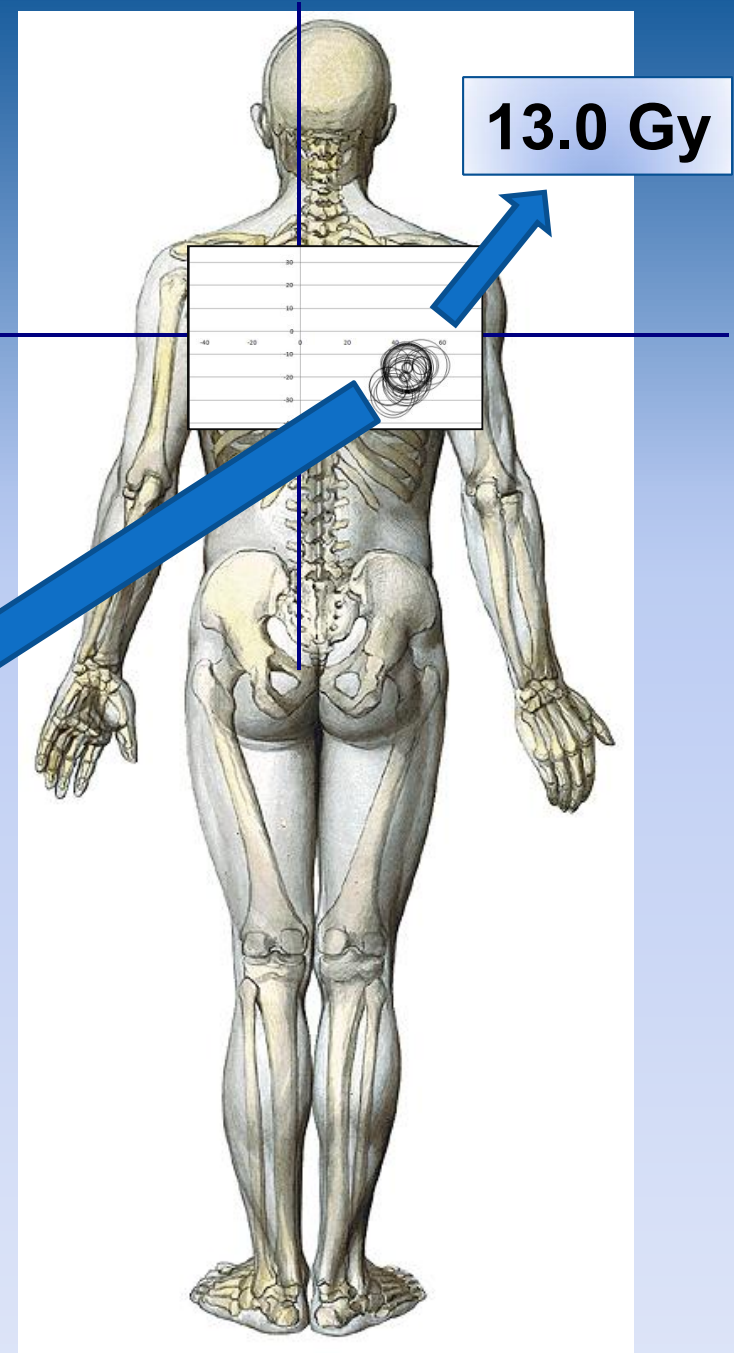
**Thus, 16-27% of procedures likely result in
> 0.5 Gy to the heart (organ dose)**

CLINICAL INVESTIGATION

Importance of a Patient Dosimetry and Clinical Follow-up Program in the Detection of Radiodermatitis After Long Percutaneous Coronary Interventions

Eliseo Vano · Javier Escaned · Sergio Vano-Galvan ·
Jose M. Fernandez · Carmen Galvan

For some complex procedures, absorbed dose to the skin can be several Gy and heart doses can be much higher than 0.5 Gy



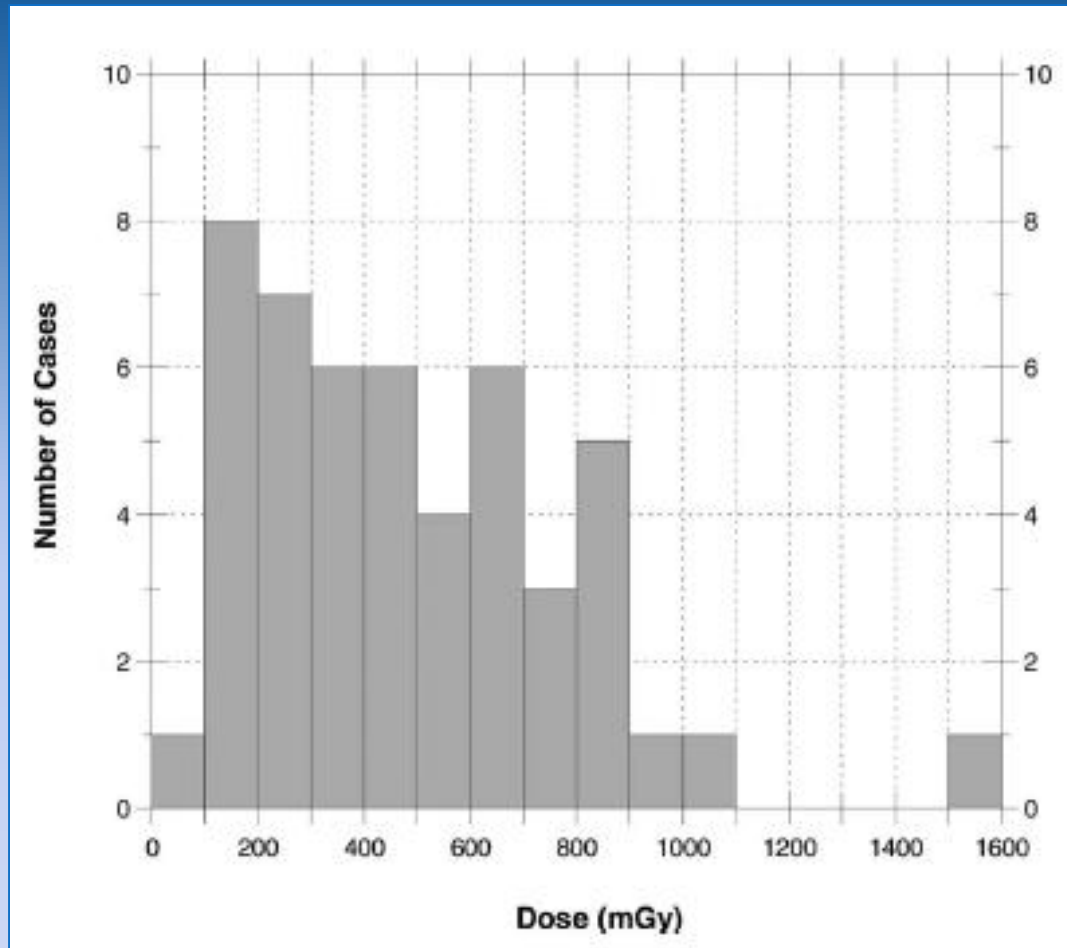
Interventional neuroradiology procedures (evaluation made at the SCUH in Madrid)

- The radiation dose delivered to the brain was estimated using MC software in 99 diagnostic and therapeutic neuroradiology procedures. A total of 9031 beam projections were processed.
- For cerebral embolizations, average brain doses were 0.5 Gy. **In 34% of cases brain doses were ≥ 0.5 Gy.**
- A CAK of 1000 mGy implies approx. 270 mGy to the brain.
- Estimation of brain doses should be part of the optimization process (and informed consent) especially for patients who have undergone several procedures and for paediatric patients.

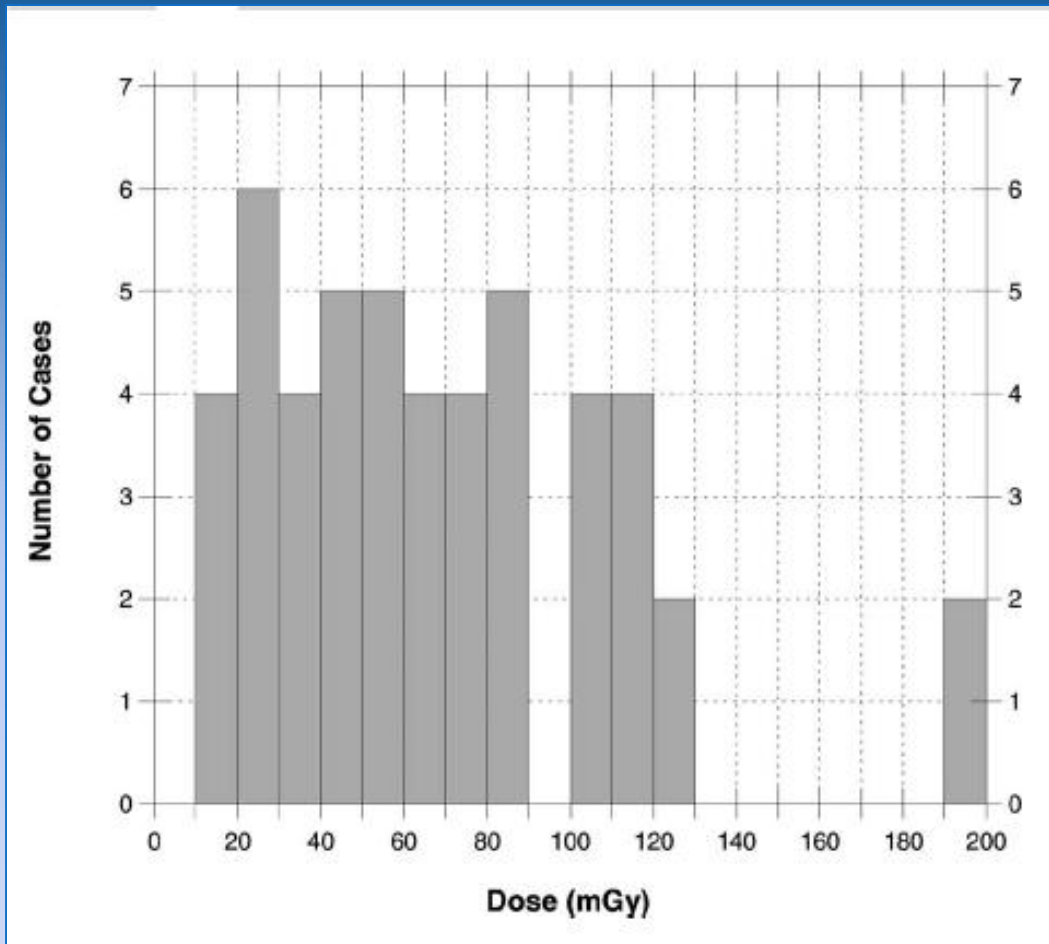
Relevance in **paediatric
interventional
neuroradiology**

**Brain doses in paediatric
neuroradiology
procedures**

*I. Thierry-Chef, S. L.
Simon, C. E. Land
and D. L. Miller
RADIATION RESEARCH
170, 553–565 (2008)*



Average absorbed doses to the brain when exposed to
large uniform fields
(49 neuroembolizations; 21 (43%) > 500 mGy)



Brain doses in paediatric neuroradiology procedures

*I. Thierry-Chef, S. L. Simon,
C. E. Land
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*RADIATION RESEARCH 170,
553–565 (2008)*

**Impact of optimization
(e.g. good collimation)
but consider difficulties
for organ
dose estimations**

**Average absorbed doses to the brain when exposed
to small, non-uniform fields. All < 0.5 Gy.
(49 neuroembolizations)**

Implications in medical imaging. Impact on occupational protection

- The new dose thresholds **also affect occupational protection for operators and other staff.**
- Some operators do not protect their eyes or their brain adequately.
- After **several years of work without proper protection, absorbed doses to the lens and to the brain of staff can exceed 0.5 Gy.**

Radiation-associated Lens Opacities in Catheterization Personnel: Results of a Survey and Direct Assessments

Eliseo Vano, PhD, Norman J. Kleiman, PhD, Ariel Duran, MD, Mariana Romano-Miller, MD, and Madan M. Rehani, PhD

Posterior subcapsular lens changes characteristic of ionizing radiation exposure were found in 50% of interventional cardiologists and 41% of nurses and technicians but only 10% of controls. Estimated **cumulative eye doses ranged from 0.1–18.9 Sv**. Most lens injuries result from several years of work without eye protection.

Implications in medical imaging of the new ICRP thresholds for tissue reactions

- The new thresholds for tissue reactions, and the need for **specific patient and staff dose evaluations and follow-up**, must be considered in radiation protection programs and **should be included in the education and training of professionals** involved in fluoroscopy-guided procedures.

Existing Applicable ICRP Guidance

- **ICRP #85** . Avoidance of Radiation Injuries from Medical Interventional Procedures.
- **ICRP #105** . Radiological Protection in Medicine.
- **ICRP #113** . Education and Training in Radiological Protection for Diagnostic and Interventional Procedures.
- **ICRP #117** . Radiological Protection in Fluoroscopically Guided Procedures Outside the Imaging Department.
- **ICRP #120** . Radiological Protection in Cardiology.