

Correspondence

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What are the implications of the proposed revision of the eye dose limit for interventional operators?

The Editor,

The International Commission on Radiological Protection (ICRP) has reviewed epidemiological evidence on tissue reactions and concluded that the threshold dose for observable effects in the lens of the eye is an absorbed dose of 0.5 Gy. Following this, the ICRP have issued a statement proposing that the occupational dose limit for the eye is reduced from 150 mSv to 20 mSv, averaged over a defined period of 5 years, with no single year exceeding 50 mSv [1]. Staff who are likely to exceed a dose constraint equal to three-tenths of the dose limit would need to be classified as radiation workers; however, the limit is applied to an average dose over a period of 5 years, which allows some flexibility in single years. If a reduction of this magnitude were introduced it could have major implications for operators performing interventional radiology and cardiology procedures.

I published a paper in the *British Journal of Radiology* earlier this year reviewing dosimetry studies for interventional radiologists and cardiologists that gave indicative levels of workload in terms of dose-area product (DAP) and number of cardiology procedures on which assessments of doses to various parts of the body could be based [2]. Workloads derived using a similar approach based on the proposed limits are compared with the current situation in Table 1. The DAP to eye dose conversion factors were based on the third quartile of data from the studies reviewed [2]. Results are also included in Table 1 using eye dose conversion factors based on the median doses from the reported studies. Application of the third quartile value suggests that a cardiologist performing more than six procedures per month would be required to be a classified worker. Even if the median value is applied, this would only allow an interventionalist to perform 15 cardiology procedures per month before classification was required (Table 1). Thus, the proposed change in dose limit is likely to result in the

need for most interventionalists to become classified radiation workers. Under the Ionising Radiations Regulations 1999, assessments will then be required for doses to the eye and body received by the interventionalists and those to the hand where these are likely to be significant [3]. The dose records must be kept by an approved dosimetry service. Where an interventionalist works in both the National Health Service and private practice, co-operation is required between the employers to establish the total dose received. The interventionalists must also have an annual health review by an appointed doctor to certify they are fit to work. Copies of the dose and health record must be obtained from the previous employer when an individual starts work for a new employer. Arrangements must be in place for both records to be kept for a period of at least 50 years from the time an individual ceases to be a classified worker.

Eye dose can be reduced through the use of ceiling suspended shields or the wearing of lead glass spectacles. In fact the majority of studies reviewed included use of eye protection. However, doses up to 400 μ Sv have been reported from single complex interventional cardiology and radiology procedures when no protection is used [4,5], so there is the potential that an eye dose at the level requiring classification could be reached after only 15 to 20 procedures per year. Ceiling suspended shields can reduce eye doses by factors of between two and seven and wearing lead glass spectacles with side shields by a factor of ten [6]. Thus, there is a need to encourage all interventionalists to use the protective devices available and for protection equipment suppliers to develop protective devices for the eye that interventionalists find more acceptable.

In addition there are major issues relating to monitoring eye doses for interventionalists. Firstly, the dose for monitoring should be equivalent dose to the crystalline lens of the eye at a depth of 3 mm or Hp(3). The quantity recorded by current personal dosimeters is Hp(0.07) at a depth of 0.07 mm for skin monitoring. This should be similar for diagnostic radiographs, but can differ by a factor of two or more. A component of the ORAMED (Optimisation of RAdiation protection for MEDical staff) project funded by EU Euratom is the development of a dosimeter suitable for recording the dose to the eye [6,7].

Table 1. Workload for which interventionalists would be likely to approach dose limits or constraints for the eye

Category of radiation worker	Dose constraint/limit (mSv)	Dose/DAP (μ Gy Gy ⁻¹ cm ⁻²)	DAP per month ^a (Gy cm ²)	Dose per cardiology procedure (μ Gy)	No. of cardiology procedures per month ^a
Non-classified	45 ^{b,c}	1 ^d	3500	80 ^d	50
Classified	150 ^b	1 ^d	12500	80 ^d	150
Non-classified	6 ^{c,e}	1 ^d	500	80 ^d	6
Classified	20 ^e	1 ^d	1600	80 ^d	20
Non-classified	6 ^{c,e}	0.4 ^f	1200	34 ^f	15
Classified	20 ^e	0.4 ^f	4000	34 ^f	50

^aWorkload for which individual would be likely to approach dose constraint or limit; ^bcurrent annual dose limit; ^cdose constraint equal to three-tenths limit, ^ddose conversion factors based on the third quartile of the distributions from review [2], ^eannual dose limit of 20 mSv proposed by ICRP [1], ^fdose conversion factors based on the medians of the distributions from review [2].

Secondly positioning of dosimeters to obtain accurate eye dose measurements is problematic and recent studies using sets of 10 thermoluminescent dosimeters located in a line across the foreheads of cardiologists showed that doses to the eyebrow ridge on the side nearest to the X-ray tube were 3–5 times greater than those in the middle of the forehead [6,8]. Thus, dosimeters should be worn towards the side of the head or neck adjacent to the X-ray tube, if monitoring is to be effective. Information on the findings of the ORAMED project, together with presentations and training material relating to dosimetry and protection for interventional radiologists and cardiologists is available via the ORAMED website [6]. Gaining compliance from interventionalists in using protective devices effectively in order to restrict doses to below 20 mSv per year and wearing dosimeters consistently in the correct position will present major challenges. Especially since lack of diligence in wearing dosimeters appears to demonstrate lower doses and hides protection problems.

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