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Radiation cataract and protection

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While the focus of radiation protection over the last decade has been shifting to patient protection, concerns over radiation-induced cataract have brought attention back to staff protection. Collaborative studies by this author over the last four years, as part of a project by the International Atomic Energy Agency (IAEA), have demonstrated a significant increase in the incidence of eye lens opacities among interventionists and support staff in interventional facilities [1-5]. With the lowering of the eye lens dose limit by the International Commission on Radiological Protection (ICRP) by 86.7 percent (from 150 mSv/yr to 20 mSv/yr) [6] and results of studies indicating an urgent need to educate staff involved in interventional procedures, this article is aimed at creating better awareness of recent developments and strengthening protective measures for staff involved in interventional procedures.

These studies are unique in the sense that they pertain to medical and paramedical staff involved in interventional facilities (cardiac catheterisation laboratories) whereas most other studies pertain to observations in non-medical situations, such as A-bomb survivors, Chernobyl clean-up workers, astronauts and air crew [2].

The following questions and answers provide practical guidance for avoiding eye lens injuries.

1. Who should be concerned?

Staff with potential exposure to the eye lens great enough to be concerned are:

1. Those who work near the fluoroscopy machine e.g. interventional radiologists and other medical specialists who perform interventional fluoroscopy.
2. Staff who are near the patient's table for extended periods of time when the x-rays are on (e.g. nurses, radiological technologists in some situations, other assistants, or anaesthesiologists).

Staff who remain at the console outside the x-ray room during fluoroscopy, CT or radiography are extremely unlikely to have radiation exposure beyond dose limits.

2. How does proximity affect staff exposure?

Scattered x-rays are greatest near the x-ray tube and thus the main operator and assistant who stand near the x-ray tube have potential for high exposure. The nurse, or technologist, who stays at the foot of the patient's bed has also been found to have a higher incidence of lens opacity because of a lack of protection. Thus while inverse-square law is able to decrease the radiation intensity for staff at the foot of the bed, lack of protection can still annul the decrease.

3. Is it possible to differentiate between cataract caused by x-rays and that caused by aging?

One can yes, although it may not always be possible. Opacities as a result of x-ray exposure occur generally (but not exclusively) in the posterior sub-capsular (PSC) region of the eye lens. For many years it had been believed that radiation-induced lens opacities occur only in the PSC region, but more recent data suggest that radiation-induced opacities can be found in the lens cortex as well. Age related cataracts are most commonly found in the nuclear region and cortical cataracts are commonly found in diabetic patients. If the ophthalmologist does not pay attention to the PSC region, which can often be the case due to training, there is a chance of non-detection.

4. What is the role of protective devices?

Obviously a lead apron will have no impact on eye lens dose and additional protection is needed for the eyes. The most common protective device is a ceiling-suspended screen which is highly effective when placed properly. Since some interventional procedures can make it difficult to maintain the ideal position for a shield, additional protection using lead-glass eyewear can help, and both combined can provide a high degree of protection in high workload situations. For a low workload, a ceiling suspended screen or mobile screen may be sufficient. It is not sensible to use the number of procedures to classify workload as high or low, as it depends upon the radiation 'on-time' for the procedure and the orientation of x-ray tube. It is best to ask the medical physicist to measure radiation dose to the eye in procedures normally performed and decide the efficacy of protection for the workload accordingly. It must be remembered that there is no limit on workload, but there is a limit on radiation dose. With increased protection, one can increase workload while still keeping radiation dose within limits.

5. Is it true that the current dose limit of 20 mSv/yr can easily be exceeded in high workload situations?

It can be true when protection is not used. On the other hand with adequate and proper use of protection, one can manage heavy workloads typically encountered in interventional radiology and cardiology as described above.

For further information on staff protection: https://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/6_OtherClinicalSpecialities/radiation-cataract/Radiation-and_cataract.htm

For information on typical doses to eyes of patients in various examinations and protection:
https://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/6_OtherClinicalSpecialities/radiation-cataract/radiation-cataract-patient-protection.htm

References

1. Ciraj-Bjelac O, Rehani M, Minamoto A, Sim KH, Liew HB, Vano E. Radiation induced eye lens changes and risk for cataract in interventional cardiology. Cardiology 2012 Oct 31;123(3):168-171.
2. Rehani MM, Vano E, Ciraj-Bjelac O, Kleiman NJ. Radiation and cataract. Radiat Prot Dosimetry. 2011; 147:300-304.
3. Vano, E., Kleiman, N.J., Duran, A., Rehani, M.M., Echeverri, D. Cabrera, M. Radiation Cataract Risk in Interventional Cardiology Personnel. Radiat Res. 2010; 174: 490-495.
4. Ciraj-Bjelac O, Rehani MM, Sim KH, Liew HB, Vano E, Kleiman NJ Risk for radiation induced cataract for staff in interventional cardiology: Is there reason for concern? Catheterization and Cardiovascular Interventions. 2010; 76: 826-834
5. Vano E, Kleiman NJ, Duran A, Romano-Miller M, Rehani MM.Radiation-associated lens opacities in catheterization personnel: results of a survey and direct assessments. J Vasc Interv Radiol. 2013 Feb;24(2):197-204. doi: 10.1016/j.jvir.2012.10.016. Epub 2013 Jan 28.
6. ICRP. Statement on tissue reactions. April 2011. http://www.icrp.org/docs/ICRP%20Statement%20on%20Tissue%20Reactions.pdf