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Editorials

The lens is more sensitive to radiation than we had believed

The lens of the eye has long been recognised to be one of the most radiosensitive regions of the body, but our knowledge concerning the minimal dose needed to cause cataract in the human eye has been scanty. This knowledge had advanced little since the available data of the day were reviewed by Merriam and colleagues in 1972.[1] A number of studies in the past have looked at cataract formation at various times after the event of radiation and estimation of the dose received by the eye has often been inexact as a result of inadequate data. In the survivors of the atomic bombs the estimation has necessarily been crude. With the less penetrant radiations, such as β radiation, the dimensions of the eye impose their own problems in the estimation of the dose to the lens.[2] In 1991 Calissendorff *et al*[3] showed that all children receiving total body irradiation of 10 Gy developed significant cataract. This study indicated that the threshold dose for radiation cataract in children must be below 10 Gy. A more recent paper by Henk *et al*[4] showed that in patients receiving fractionated super voltage radiation therapy for orbital tumours there was a strongly dose related incidence of lens opacities. A dose of 5 Gy or less was not associated with cataract whereas doses of 16.5 Gy or higher were invariably associated with some degree of lens opacity and impaired visual acuity. This occurred despite the fact that the lens was partially shielded during the therapy.

The paper by Wilde and Sjöstrand in this issue of the *BJO* (p 261) is exceptional in that it is a very long term follow up of γ radiation of known dose given to infants aged 2–13 months and followed up until the patients were aged 30–46 years. This work shows us that the lens, certainly that of the infant, is more sensitive to ionising radiation than had previously been considered. A dose of 2.0 Gy or more is shown to be definitely cataractogenic. However, individuals are known to vary widely in their sensitivity to radiation,[5] so that it will probably never be possible to define any single minimal cataractogenic dose of radiation.

The lens serves as a kinetograph to produce a permanent recording of the effects of transient events and the lens can be regarded as a clock.[6] Wilde and Sjöstrand have also recognised this and their study is interesting in that they have shown that events have continued in the lenses studied long after the time of the radiation. The typical radiation cataract has been considered to be a posterior subcapsular cataract, which is not morphologically differentiable from posterior subcapsular cataract of other causes. The initial damage is considered to be to the germinal epithelium at the lens equator[7] with consequential defective lens fibre formation leading to the accumulation of debris in the subcapsular region at the posterior pole. Changes have also been noted in the subcapsular region[8] with thinning of the anterior subcapsular clear zone. With time, the subcapsular clear zone reforms both anteriorly and posteriorly and the cataract is seen to become separated from the capsule, the depth increasing with time.[9] The depth of the cataract indicates its time of origin.[10] In severely irradiated cases this recovery does not occur and the cataract progresses rapidly to maturity.[8] Wilde and Sjöstrand have made the novel finding that there is often cataract formation that is superficial to the primary opacity and they have recognised that this indicates continuing defective lens fibre formation probably due to a persisting clone of damaged germinal epithelial cells. Thus, gradual continuing cataract development may follow radiation short of that causing a rapid progression to maturity.

The finding by Wilde and Sjöstrand of a low threshold for the cataractogenic dose of radiation implies that ophthalmologists should be alerted to the possibility of radiation as the cause of subcapsular cataract in individuals developing cataract at a younger age than is usual. This possibility has already been considered in the case of the Christmas Island veterans who had been present at the British atom bomb tests in the 1950s, but in this study the findings were negative and it was not possible to show that the development of cataract at a younger than normal age in these veterans was due to exposure to low levels of irradiation.[5]

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