LENS OPACITIES IN MAN AS A POSSIBLE INDEX OF RADIATION EXPOSURE: A CONTRIBUTION FROM FOLLOW-UP OF SOME IRRADIATED PATIENTS

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Slit-lamp microscopy of the crystalline lens in normal individuals often reveals the presence of small punctate opacities which are considered physiological and congenital. Investigations carried on workers professionally exposed to photonic radiations employed for medical purpose as well as on unexposed subjects show a high frequency of punctate opacities. These opacities seem to vary depending on age and not on the duration of radiation exposure.

In order to verify this issue we compared a group of workers professionally exposed to radiation to a group of patients undergoing radiation therapy for different types of tumors. We examined two groups of patients: the first one was composed bu 21 patients irradiated for head tumors (hypophysis, rhinopharynx, brain, paranasal sinuses) and the second one consisting of 22 subjects undergoing radiation therapy for neck and mediastinal tumors (tymoma, Hodgkin's disease, etc.). The therapeutic fields of radiation were classified according to the distance from the lens as "near" for the former group of patients and "distant" for the latter one.

All patients but one who received linear accelerator radiation therapy were irradiated with Co^{60}. For "near" fields the tumor dose ranged from 54 Gy to 70 Gy with field ranging from 5 x 7 (epipharynx) to 13 x 18 (whole brain treatment). For "distant" fields the tumor dose ranged from 45 Gy to 64 Gy with fields ranging from 30 x 30 (Hodgkin's disease) to 12 x 13 (thyroid). In all cases the patients received from 30 to 35 fractions.

A dosimetry of the crystalline lens by means of thermoluminescent dosimeters (T.L.D.) was performed on the Rando-Alderson phantom. The T.L.D. readings outside the radiation fields were compared with calibration measurements obtained by a ionization chamber applied to the standard polystyrene phantom. The simulation of the therapeutic fields required the use of radiation fields suited to the size of the phantom. Further measurements near the lens were obtained "in vivo" to test the difference of the per cent dose to the lens measured on the phantom. This technique revealed a lens dose for "near" fields varying

from 5% to 27% of the maximum tumor dose with Co60 and from 1% to 7,5% of the maximum tumor dose released by Rx 9MV delivered by a linear accelerator (one case). In the 21 patients irradiated for head tumors an increase of punctate opacities was detected in 70% of cases at the end of the treatment and/or in the follow-up after three months.

In the 22 subjects undergoing radiation therapy with "distant" fields the lens dose varied from 2,6% to 2,8% for neck treatment and 5,2% and 6% of the maximum tumor dose for mediastinal Hodgkin's disease and tymoma with linear accelerator (one case) and Co60 respectively. The evident difference between the neck nodes treatment and the mediastinal fields is due to the fact that the dose to the lens depends on several factors given by the energy of the beam and the size of the source, the size and the shape of the field, the distance from the geometric border and the composition of the diffusion mean. Fifty per cent of these patients showed an increase of the lens opacities at the end of the treatment and/or at the follow-up after three months.

In conclusion, we could observe that our patients revealed within 3 months an increase of lens opacities in 70% of the subjects treated with "near" fields and in 50% of those treated with "distant" fields. In all subjects the dose at the level of the lens was not negligible varying from a minimum of 0,45-0,50 Gy for a 4 x 4 cm. field (as that employed for the treatment of a hypophyseal tumor) to a maximum of 13,5-14,5 Gy for a whole brain treatment field.

The regular increase of punctate opacities associated with radiations showed the existence of a possible relationship between high radiation doses and punctate opacities. This relationship cannot be easily explained. In fact, the hypothesis of a direct damage to the lens germinal epithelial cells seems unreliable for the short interval of time occurring before the onset of the punctate opacities (germinal epithelial cells mean turn-over in man extrapolated from radiobiological investigations ranges from one to two years). Thus, indirect mechanisms given by alterations of metabolic and nutritional processes and radio-induced lesions of the ciliary processes could be invocated.

Further studies are required at this purpose; in the meantime the follow-up of the forementioned patients is continuing. However, in our opinion, the research of the punctate opacities in radio-exposed individuals may be a valid parameter or at least a factor deserving further consideration in order to identify an index of radiation exposure of the lens.