MECHANISM OF ACTION FOR THE INDUCTION OF CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTE CULTURES BY LOW-LET (ß-, X-, -) IRRADIATION

K. Brandenburg, U. Seydel, B. Lindner
Forschungsinstitut Borstel
Div. of Biophysics
2061 Borstel
F.R. Germany

The yield in chromatid breaks, dicentrics, and sum of all aberrations (except for gaps and fragments) induced in human peripheral lymphocyte cultures by different ß-sources (H-3, S-35, P-32) was investigated and compared with the respective effects of electromagnetic radiation (X- and γ-rays).

From the results for the coefficients α and β of the linear-quadratic relationship a hypothesis was derived concerning the mechanism of action. The proposed assumption that the DNA is not the only radiation sensitive site within the cell, but that the nuclear membrane seems to play also an important role, is in accordance with our observation of a much stronger suppression of lymphocyte viability especially by acute ß-irradiation than by X-rays. To prove the hypothesis the absorption of ß-electrons in the nuclear membrane, i.e. the slowing-down of the continous ß-spectra, was calculated for H-3 and P-32 and related to the different behaviours of short-range H-3 ($\beta \approx 0$) and long-range P-32 ($\beta > 0$). In this way an interpretation for the lacking of the quadratic term for H-3- no intertrack interactions- can be given in terms of a strong disturbance of the low energy radiation fields.

For the dependence of the dicentric yield on dose rate a significant decrease of the linear coefficient α which is supposed to be independent on dose rate was found for protracted irradiation. This can be interpreted by different radiation sensivities in resting phases G_0 and cell cycle phases G_1-S-G_2 for acute and chronic irradiation, respectively. In any case, repair and recovery mechanisms are of secondary importance.

With the aid of a comprehensive statistical analysis the distributions of chromosome aberrations were compared with Poisson, Neyman-type A, and lognormal distributions, and the fit was examined with a - -test. The obtained results are in accordance with the above proposed hypothesis and support the specified mechanism of action.