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LYMPHOCYTE CHROMOSOME ABERRATIONS IN PATIENTS UNDERGOING RADIATION THERAPY FOR MAMMARY CARCINOMA

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Chromosome aberrations induced in peripheral blood lymphocytes of man are widely used as a biologic indicator of exposure to ionizing radiation. Since most lymphocytes recirculate through the body (TREPEL 1975, 1976) the yield of aberrations after partial body irradiation is directly related to the sensitivity of lymphocytes to radiation as measured in vitro and to the volume of irradiated blood and tissue. Preliminary observations on 6 female patients given telecobalt therapy for mammary carcinoma showed that the number of aberrations, although subject to large inter-patient differences, increased with the absorbed dose and could be fitted to either a power or a quadratic function whereas the fit to a linear function was less good but still acceptable (ANTOINE et coll. 1981).

The present paper reports the results of additional observations in a series of 10 female patients also undergoing radiation therapy for mammary carcinoma under comparable conditions of exposure.

Materials and Methods

The patients were treated with a ^{60}Co unit (Picker) according to the following protocol: The mammary area was irradiated by means of two opposed tangential fields ranging from 10.5 cm × 9 cm to 17.2 cm × 9 cm. The internal mammary lymph node area was involved in the target volume, and pulmonary protection was obtained by a lead block covering half of the field (Fletcher's technique).

The field of the axillary and supraclavicular lymphatic areas was partially reduced by shielding blocks for pulmonary and humeral protection, and ranged from 134 cm^2 to 204 cm^2. The internal mammary lymph node area varied from 7 cm×11.5 cm to 7.5 cm×15 cm.

Absorbed doses of 2.5 Gy were delivered to each target volume daily four times a week. None of the patients had been previously treated by irradiation or chemotherapy.

Blood samples were taken before the first irradiation session and 24 h after absorbed doses of 10, 20 and 30 Gy to each target volume.

Blood culture, scoring of chromosome aberrations and statistical analysis were performed as described in the previous paper (ANTOINE et coll.).

Results and Discussion

The results of the observations are summarized in Table 1. The Figure presents the dose effect curve for the present patients as well as that published earlier (ANTOINE et coll.) for patients also submitted to telecobalt therapy.

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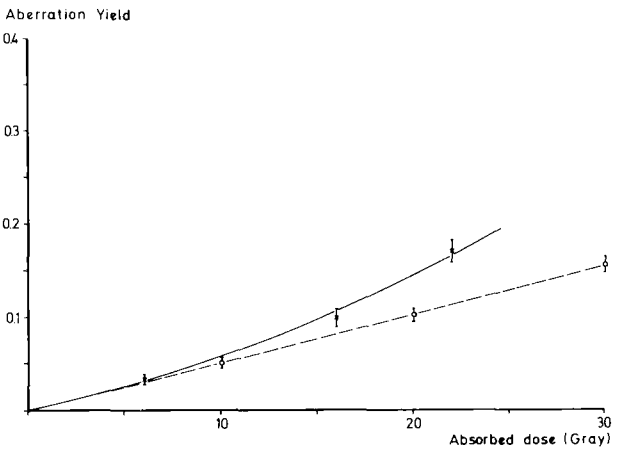
The curve now obtained yielded fewer aberrations, particularly in the high dose range. Whereas the alpha term for the quadratic law was nearly the same, the beta term was much smaller. In both cases, however, the fit to the curve was excellent but a significant inhomogeneity existed between the different patients due to their different reactions to radiation.

The reasons for the divergence are not entirely clear. EKSTRAND & DIXON (1982) have shown that for fractionated partial body irradiation the beta term decreases as the percentage of lymphocytes exposed diminishes. These authors presented a formula which describes well the earlier data reported (ANTOINE et coll.). In the present investigation a larger single dose (2.5 Gy instead of 2.0 Gy) was utilized. According to the formula given, the size of the fraction did not greatly influence the beta parameter, but the percentage of lymphocytes exposed did so. In the present radiation schedule the internal mammary lymph node area was not exposed as in the earlier schedules, and additional pulmonary protection was achieved by lead shielding during tangential irradiation of the breast. It is thus possible that the number of lymphocytes exposed was correspondingly smaller.



Dose effect curves in linear scale for the induction of dicentrics during radiation therapy for mammary carcinoma. The curves represent a fit for a quadratic law. Data from ANTOINE et coll. (—) and present investigation (- - -).

SUMMARY

Patients undergoing radiation therapy for mammary carcinoma have been cytologically examined for the presence of polycentric chromosomes in their peripheral blood lymphocytes. The mean values of the observed yields can be fitted to a quadratic function. Due probably to a lower number of lymphocytes exposed the curve now obtained gives a smaller aberration yield than the dose effect curves published earlier for patients given telecobalt therapy.

Table 1

Frequency of dicentric chromosomes after irradiation of patients treated for mammary carcinoma (200 cells examined per point)

Case	Age (years)	Controls	10 Gy	20 Gy	30 Gy
1	67	1	14	25	31
2	40	0		7	27
3	59	1	28	37	63
4	39	1		16	36
5	43	0		33	27
6	58	1	12	30	36
7	56	0	8	20	35
8	58	2	4	10	16
9	64	3	6	19	23
10	58	3	10	19	30
Mean (±SE)		1.2±0.36	11.7±3.01	21.6±3.06	32.4±3.93

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Table 2

Parameters (±SE) of the dose effect curves (quadratic law: $Y=\alpha D+\beta D^2$) for induction of dicentrics

Investigation	α ($\times 10^4$)	β ($\times 10^6$)	Sum of squares
ANTOINE et coll. (1981)	41.7±9.6	13.0±5.5	0.08
Present data	49.7±1.0	7.44±2.21	0.73

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