THE FREQUENCY OF DICENTRIC CHROMOSOMES IN RELATION TO ^{131}I CONTAMINATION

D. Kubelka, A. Fučić and V. Garaj-Vrhovac
Institute for Medical Research and Occupational Health, Zagreb, Croatia

INTRODUCTION

In vitro investigations conducted by now have indicated a correlation between the applied doses of ionising radiation and frequency of dicentric chromosomes (1). In vivo investigations do not always confirm that relationship, especially not in case of subjects occupationally exposed to ionising radiation. The aim of this paper was to elucidate that possible disagreement between registered doses and the number of chromosomal aberrations may be ostensible. Risk estimation should therefore involve precisely defined groups of examinees and not individual subjects.

SUBJECTS

Out of the total number of 107 subjects included in the study, 41 subject were taken as a control group and 66 workers employed at a department of nuclear medicine represented exposed group. The subjects had not been exposed to radiation for therapeutic or diagnostic purposes over the preceding year and had not taken any chemo-therapeutic drugs.

The activity of the department of nuclear medicine involves the use of radioactive material for therapeutical treatment and diagnostics. The variety and wide range of specific jobs at the department of nuclear medicine requires the staff including different professions. All these employees; such as cleaners, nurses, technicians, physicians, biologists, physicists and chemists, have in common equal possibility to be irradiated in their everyday work. Irradiation may occur during the handling of radioactive material, in the process of application of radioactive material to patients, from the patient subjected to application of radioactive material and by contamination. It should be emphasized that work at the department of nuclear medicine involves a risk for the employees to be continuously exposed to ionising radiation over the whole working hours. Since the risk from external irradiation, from contaminatin and intake of radionuclides in the body depends mainly on the nature of specific tasks of the employees, the exposed group was divided into four subgroups by corresponding jobs and tasks performed daily at the department of nuclear medicine.

METHODS

Analysis of chromosomal aberrations were carried out on standard 24-hour lymphocyte cultures. Two hundred metaphases were analysed per each sample, and only first in vitro metaphases were analysed. Chromatid and chromosomal damages detected per each analysed metaphase were classified into chromatid breaks, chromosomal breaks and bicentric chromosomes (2).

Samples of urine to be gamma-spectrometrically analysed were collected in glass dishes over 24 hours. Daily aliquot in the volume of 110 ml per subject was taken for analysis. Gamma-spectrometrical analysis of 24-hour urine samples was carried out using Ge (Li) detector, resolution 1.78% (Co), efficiency 16.8% with 4K channel analyser, Canberra series 10. The detector was protected with a lead layer, thickness 10 cm, 1 mm of cadmium and 2 mm of copper. The samples were measured in a cillindric dish, volume 110 ml. Specific activities of ^{131}I were calculated on basis of known efficiency of the counter, percentage of gamma rays, quantity of the sample and intensity of photo peak.

RESULTS AND DUSCUSSION

The frequency of total chromosomal aberrations found in the control group was 0.75%, and in the group of employees of the department of nuclear medicine 1.84%. The frequency of individual chromosomal and cromatid aberrations per cell was given in Table 1.

Group	Cromatid break	Chromosomal break	Acentric	Dicentric
Control	1.34 ± 1.33	0.78 ± 1.0	0.63 ± 0.86	0
Exposed	1.97±1.22	1.56 ± 1.52	1.67 ± 1.62	0.48± 0.85

Table 1. Total frequency of cromatid and chromosomal aberrations per cell

By means of gammspectrometrical analysis ^{131}I contamination was stated in 11 subjects of the exposed group. Activity of I in urine ranged in some workers from 0 to 78.66 Bq/kg. In the control subjects ^{131}I contamination was not detected.

Comparing aberration frequency in the control and exposed group the difference between the groups was found at the level of significance $P < 0.05$, except for chromosomal breaks. The results obtained correspond with the data reported by Pohl-Ruling (3,4) pertaining to frequency of chromosomal aberrations in the lymphocytes of subjects exposed to external gamma radiation and internal radiation of radon and its decay products.

Comparing the frequency of dicentric chromosomes with ^{131}I burden in certain examinees no regularity was found between the two investigated parameters.

According to the obtained data and equal possibility of external exposure to radiation and contamination workplaces and tasks at the department of nuclear medicine, the staff was divided into four subgroups regardless of their profession.

The average values for the frequency of dicentrics per cell and examinees and data on average contamination by individual subgroups were given in Figure 1.

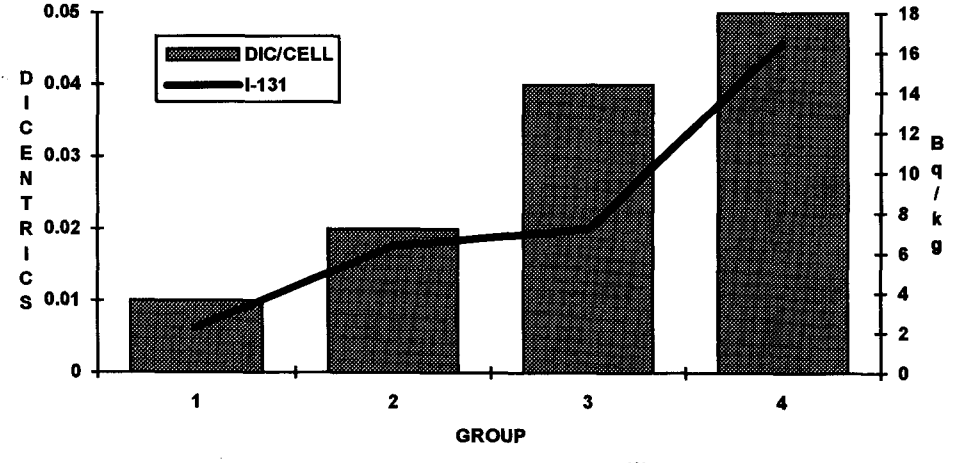

Figure 1. Average frequency of dicentrics, average contamination with ^{131}I for subgroups of examinees in the department of nuclear medicine

It can be seen that increase in the average ^{131}I contamination is followed by the average frequency of dicentric chromosomes in all four subgroups. The fact that dicentric chromosomes are found also in the subjects in whom ^{131}I contamination was not observed can be explained by the biological half-lives of ^{131}I and the time of its decay. As biological half-life of ^{131}I is 12 days and of the decay 8.04 days, there is low probability that it would be detected in urine during periodical sampling, taking into account that contamination is not

continuous. This fact is opposed by the fact that persistence of chromosomal aberrations takes several months to several years.

Taking this into account it seems appropriate to believe that for this reason the authors in previous investigations have not found any correlation between the registered doses and incidence of dicentric chromosomes.

The obtained data indicated the existence of regularity of the dose-response relationship in case of dicentric chromosomes even in cases of irradiation with small fractionate doses over the prolonged period of exposure.

Analysing the data obtained in this kind of investigations it should be mentioned that conclusions should not rely on physical measurements only. The subjects should be observed in subgroups due to their tasks which ensures great probability that doses received would be equal.

LITERATURE

1. D. Kubelka,Đ. Horvat and N. Sviličić, Studia Biophysica 123,95-100 (1988)
2. IAEA, Biological dosimetry, Technical Report Series No 260, IAEA,Vienna, 59-63 (1986)
3.J. Pohl-Ruling, P. Fischer , Radiat. Res. 80,61-81 (1979)
4.J. Pohl-Ruling, Advances in Mutagenesis Research,Vol.2,155-190 (1990)