PRESENT STATE OF BIOLOGICAL DOSIMETRY IN CUBA.

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ABSTRACT

The most significant research in biological dosimetry by chromosome aberration analysis carried out in Cuba includes: the establishment of dose response relationship for chromosome aberration and micronuclei, the examination of 56 persons involved in minor radiological incidents, the study of 69 children from areas affected by the Chernobyl accident, and 10 persons irradiated in Goiania, as well as the co-ordination and performance of an intercomparison exercise in cytogenetic dosimetry with the participation of laboratories from Argentina, Brazil, Chile and Peru.

Biochemical indicators suggested for the evaluation of persons accidentally exposed to high radiation dose are available.

The possible use of nucleic acid concentration in blood leucocytes, as an early predictor of survival possibility of irradiated persons is now under study in whole body irradiated patients for bone marrow transplantation.

INTRODUCTION

Research in biological dosimetry started in Cuba in 1985 with the foundation of the Center for Hygiene and Radiation Protection. The main objective for biological dosimetry at that time was to introduce in the country the methods for cytogenetic dosimetry. Later, some researches with biochemical indicators of radiation injury were started. This paper presents the most significant results achieved in the past ten years.

CYTOGENETIC DOSIMETRY

Dose response relationship for chromosome aberration and micronuclei were obtained by "in vitro" irradiation of human blood with ^{60}Co in 0.5 - 4 Gy dose range at a dose rate of 1.26 Gy/min for chromosomal aberration and 0.43 Gy/min for micronuclei.

For obtaining metaphases, cultures of 48 hours of 1 ml of total blood in 9 ml RPMI 1640 culture medium supplemented with 10% of fetal calf serum with the presence of phytohemaglutinin were used. For obtaining binucleated lynfocytes equal rates of culture medium and blood, both volumes four times smaller, culture time of 69 hours and cytochalasin B in 6 μg/ml concentration were used.

The dose response curves have been fitted to the linear quadratic model by the Papworth method (1).

The relationship between the frequency of aberrations/ 100 cells (Y) and dose (Gy) is:

for dicentric $Y = 0.0+(2.84\pm0.97)D+(4.68\pm0.38)D^2$

for micronuclei $Y = 1.19\pm0.28+(1.48\pm0.55)D+(3.33\pm0.22)D^2$

Up to the moment, 56 persons involved in minor radiological incidents have been analyzed. Hospital workers are more frequently involved in such incidents. In five cases dicentric frequencies were above normal.

A computer program which includes U-test and dose estimation in total and partial irradiations was developed and is used in Cuba and other Latin American countries for cytogenetic dosimetry.

CYTOGENETIC STUDY OF CHILDREN FROM AREAS AFFECTED BY THE CHERNOBYL ACCIDENT

Children from areas affected by the Chernobyl accident have been receiving medical care in Cuba since 1990. As part of the radiological assessment, chromosome aberrations and micronuclei frequency were established in 28 (19 males) children evacuated from Pripyat, 21 (8 males) living in Kiev and 20 (10 males) from Ovruch. The number of scored metaphases and binucleated lymphocytes was: 11425 and 13500 in Pripyat, 5406 and 13959 in Kiev, and 2779 and 9891 in Ovruch.

Dicentric and micronuclei frequencies per 100 cells were: 0.02±0.01 and 0.56±0.06 in Pripyat, 0.04±0.03 and 0.60±0.06 in Kiev, and 0.03±0.03 and 0.87±0.09 in Ovruch. All individual frequencies were normal.

CYTOGENETIC STUDY IN PERSONS IRRADIATED IN GOIANIA

Translocations (G-banded cells), dicentrics and micronuclei frequencies were established in 1992 in 10 persons (4 males), 8 with 4.40 - 0.15 Gy dose and 2 "intra-utero" exposed during the Goiania accident.

Dicentric frequencies above normal were found in 2 persons (4.4 and 1.1 Gy). For the first person, the dicentric frequency has decreased 100 times, for the second one, 10 times since the accident occurred. All

micronuclei frequencies were normal. Translocations and dicentric frequencies were similar in a 4.4 Gy-exposed individual.

INTERCOMPARISON IN CYTOGENETIC DOSIMETRY

As a part of a regional IAEA collaborative project, laboratories from Argentina, Brazil, Chile, Cuba and Peru participated in an intercomparison in cytogenetic dosimetry. Human lymphocytes were irradiated with ^{60}Co (0, 0.75, 1.5 and 3.0 Gy). Code slides for chromosomal aberration and micronucleus analysis were prepared by the organizing laboratory and sent to the other participants. Dicentric and micronuclei frequency were used for dose estimates.

Eleven of the 15 estimates of dose based on dicentrics and 9 of the 12 based on micronuclei fell within ± 30% of the true dose. When considering the uncertainties of the dose estimates, the true doses fell within the 95% confidence limits of the estimates on 8 of the 15 occasions for dicentrics and 4 of the 12 for micronuclei. In summary, the scoring for all 5 laboratories was similar and it was concluded that they can contribute to the scoring of blood samples for dose estimations in a large scale radiation accident (2).

BIOCHEMICAL INDICATORS

Radiation produces a drop in concentration of nucleic acid in peripheral blood leukocytes (3).

The nucleic acid dynamics in 14 whole body irradiated patients for bone marrow transplantation and 16 breast irradiated women was studied. A peak on the nucleic acid concentration curve obtained was observed 16 - 18 days after whole body irradiation in successful cases. Fig 1 show the nucleic acid dynamics and leukocytes count in one patient irradiated up to dose of 10 Gy (4 Gy + 6 Gy in days -2 and -1 before bone marrow transplantation at day 0). The prospects of using this indicator in the follow-up of the bone marrow recovery is under study.

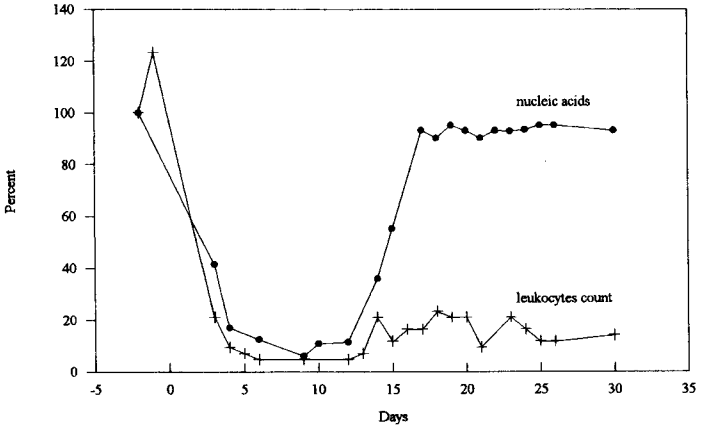

Fig 1. Nucleic acid dynamics and leukocytes count after whole body irradiation

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