APPROACHES OF THE CYTIGENETICAL DOSE EVALUATION OF THE IRRADIATION NONUNIFORMITY

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1. Introduction. The radiation exposure nonuniformity is typical for large number of accidental irradiation cases. Different cytogenetic approaches (Dolphin's and Qdr-methods) can be used for a detection of a fact of irradiation nonuniformity and dose evaluations, but they are semiquantitative and can be used after partial body irradiation only.

2. Objective is the elaboration of new method of exposure nonuniformity evaluation on a base of special computer program.

3. Method. In our Center Dr. Filushkin proposed the computer program which permits to represent any non-Poisson distribution as sum of several Poisson distributions. It permits to recover lymphocyte distribution by dose from dicentric distribution by lymphocytes. Apparently the dose distribution by lymphocytes reflects dose distribution by the body mass. But dose dependent effects of interphase death and mitotic delay of irradiated cells can influence on a yield of chromosome aberrations at non-uniform exposure. We produced special experiments with a use of mixed lymphocyte cultures of equal volumes of irradiated and unirradiated blood after in vitro gamma-irradiation (1-8 Gy) of healthy donors blood of for quantitative estimation of the influence of these factors. Then dicentrics frequencies in mixed cultures compared with its frequencies in corresponding cultures of uniform irradiated lymphocytes. Found cells distributions by number of dicentrics contained into them were put to our computer processing.

4. Results. As one might expect the fraction of exposed lymphocytes is equal 100% and dose estimations to these are near to doses estimated by medium frequencies of dicentrics in uniformly irradiated cultures. Per contra the recovered value of the fraction of exposed cells depended on dose in mixed cultures (fig. 1). Also values of recovered doses to irradiated fractions were always somewhat lower in mixed cultures than in cultures of uniformly irradiated lymphocytes what is particularly clear at dose 8 Gy (fig. 2). We suggested corresponding equations for the correction both the volume of irradiated fraction and the dose estimation value in cases of nonuniform exposure. This approach can be used for any type of dose distribution on body.

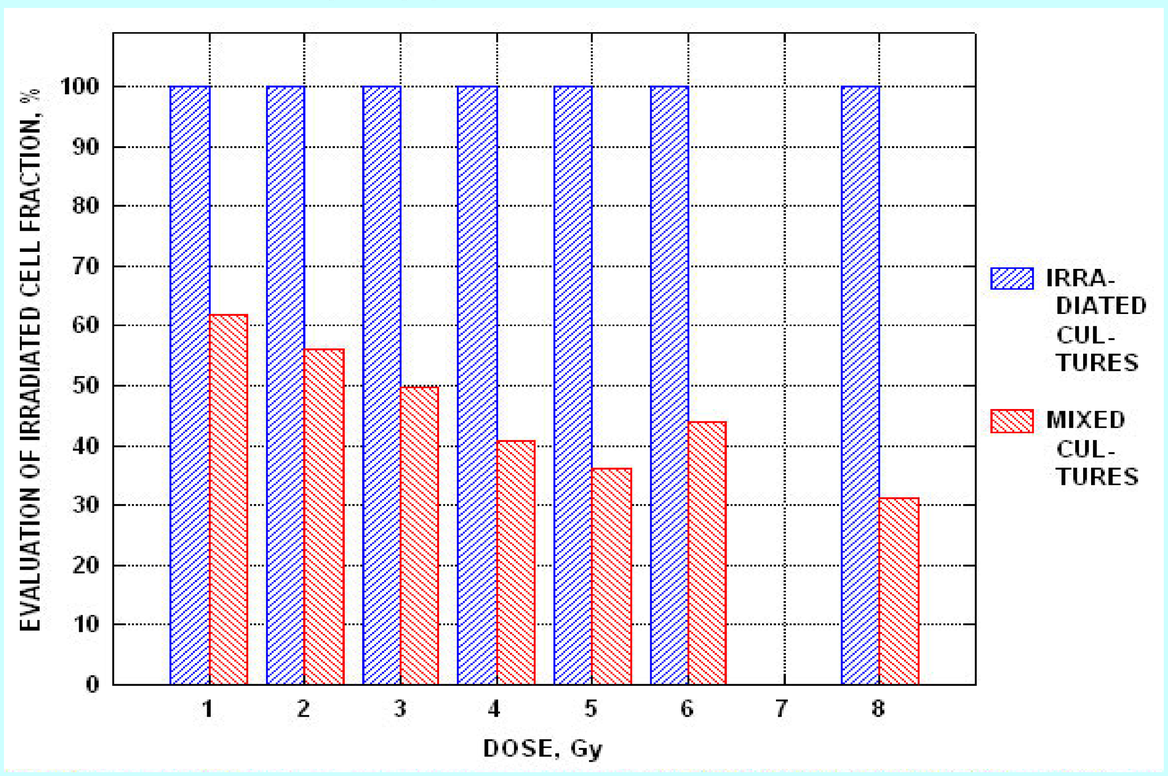

Fig. 1.

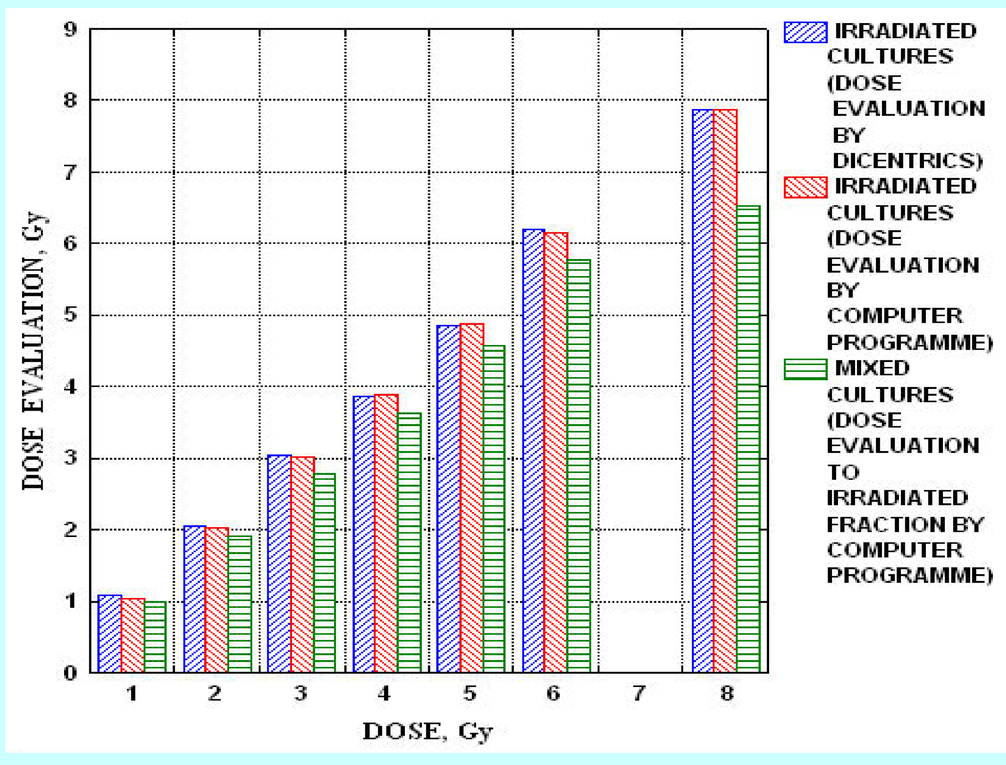

Fig. 2.

A comparison of real curves of postirradiated dynamic of blood neutrophils number with analogous curves reconstructed from estimations of dose distributions on body mass on basis of this computer analysis was realized for 10 patients exposed by acute external nonuniform gamma-irradiation. As a whole satisfactory results were received. For example, corresponding figures are presented below for 2 patients from this group (fig 3, 4).

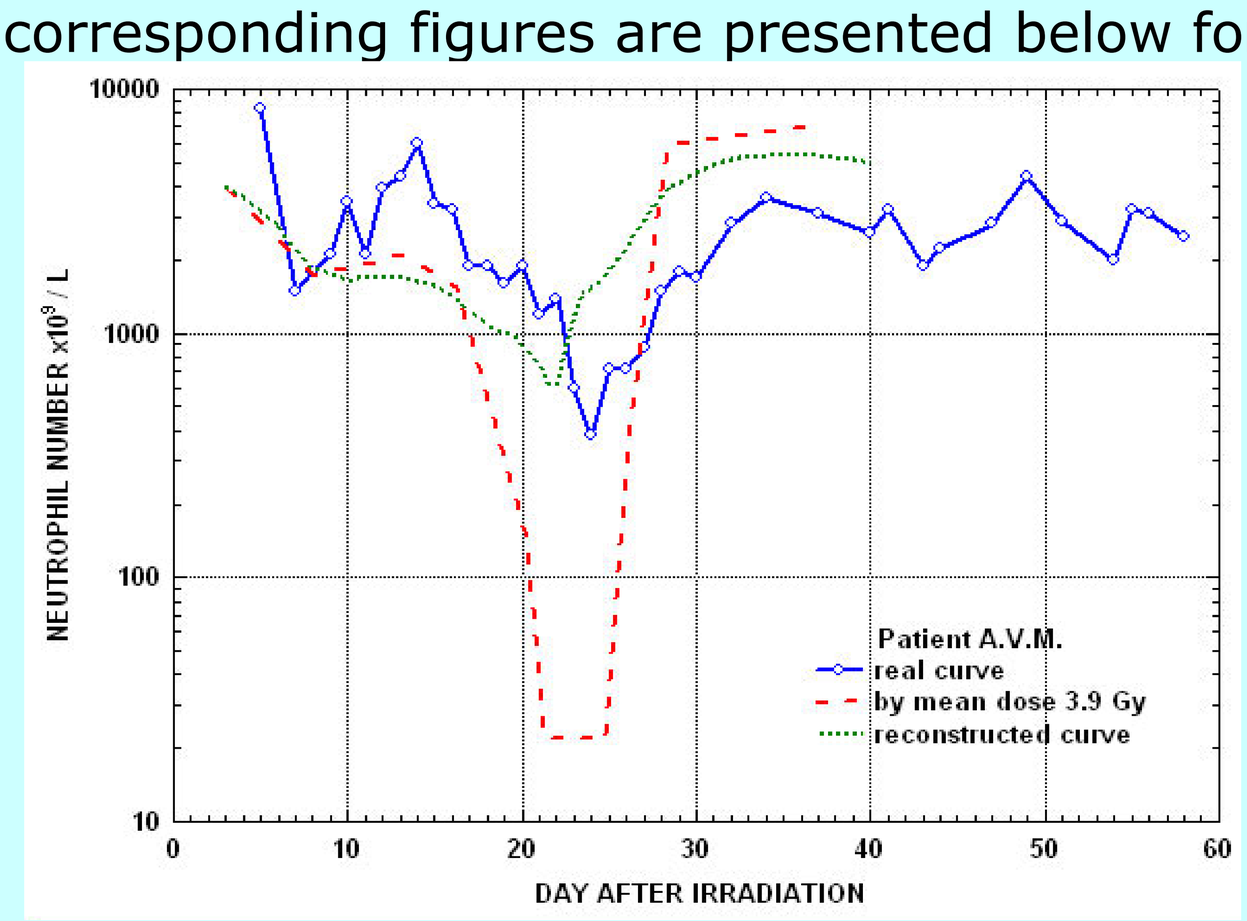

Fig. 3.

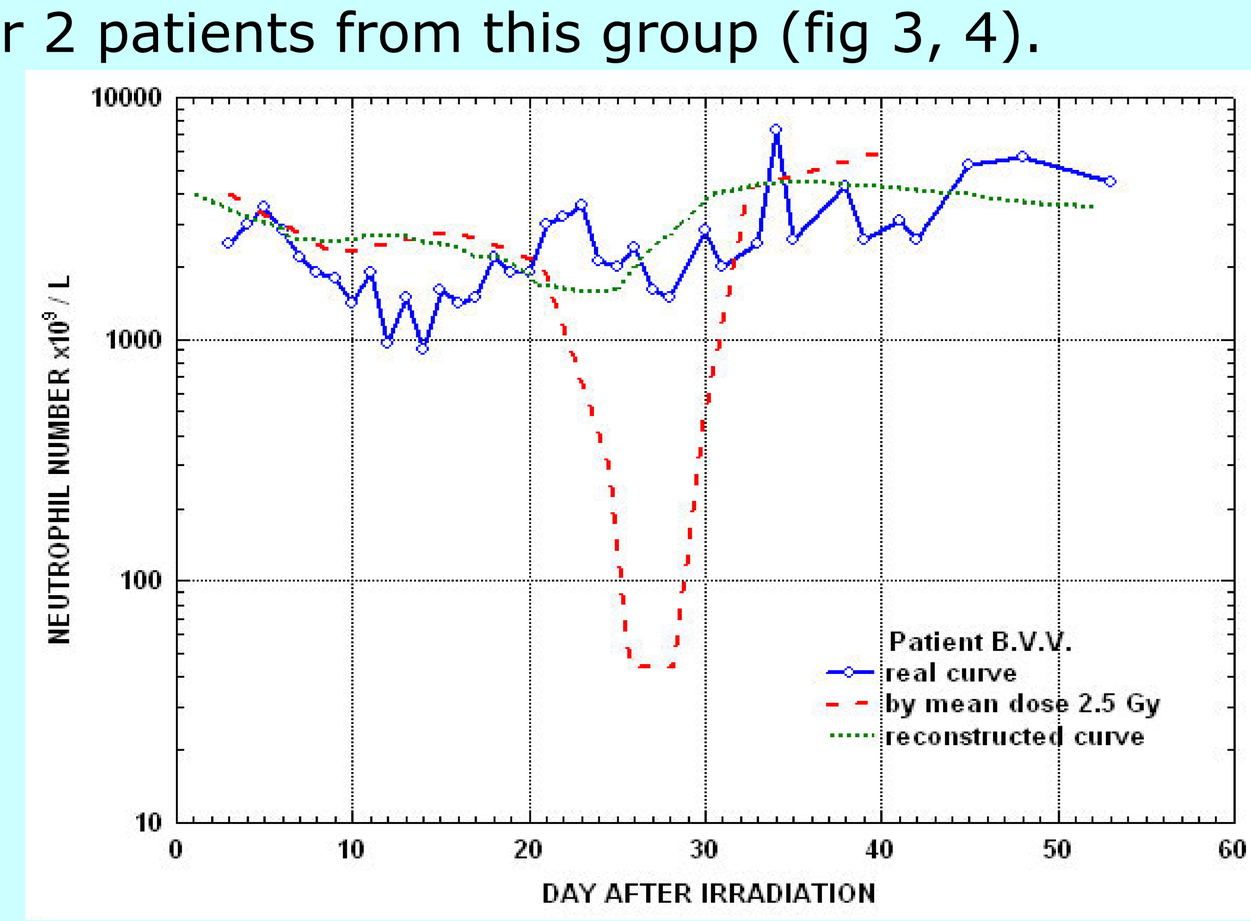

Fig. 4.

5. Conclusions. This computer method can be used for a prognosis of bone marrow syndrome gravity by cytogenetic analysis results of peripheral blood lymphocyte culture after acute nonuniform irradiation. But it is necessary to make the correction both the volume of irradiation fraction and the dose estimation value.

Velcro was provided to allow us to stick our poster to the poster board.