

The modern ecological state of the country's territory is due, on the one hand, to the degree of economic use, radioactive, chemical and bacteriological contamination of individual components of the natural environment (air basin, soils, surface and groundwater, vegetation) and, on the other, their degree of stability.

It was found that with the action of small doses of industrial toxicants, the initial reaction of the organism manifests itself in the stimulation of protective mechanisms, which at the first stage does not affect the overall incidence rate. In the future, with prolonged action of man-made pollutants, the incidence may increase abruptly, and with the inclusion of adaptation and resistance mechanisms, the morbidity levels may again return to the previous level, after which the next upswing will occur.

The analysis of literature data indicates that the methodology of risk assessment is the most adequate methodology for fully taking into account and assessing the impact of environmental factors on public health. Experience has shown that this method is widely used in environmental medicine.

BIBLIOGRAPHY

1. Барышников, И. Л. Критерии оценки здоровья населения и качества среды обитания / И. Л. Барышников // Токсикол. Вестн. – 1996. – № 4. – С. 10–13.
2. Бонашевская, Т. И. Задачи медико-биологических исследований в гигиене окружающей среды / Т. И. Бонашевская // Гигиена и санитария. – 1993. – № 4. – С. 4–7.
3. Дубровский, В. А. Влияние некоторых загрязнителей атмосферного воздуха на заболеваемость органов дыхания детей / В. А. Дубровский, И. В. Пискарева, С. Л. Савельев // Здравоохранение Рос. Федерации. – 1996. – № 3. – С. 35–66.
4. Шевчук, Л. М. Гигиенические риски и генетические маркеры предпатологического состояния здоровья населения / Л. М. Шевчук, С. В. Федорович, А. Г. Маркова и др. – Минск: Право и экономика. – 2013. – 114 с.
5. Национальный Атлас Беларуси / РУП «Белкартография» Комитета по земельным ресурсам, геодезии и картографии при СМ РБ, – Минск, 2002. – 292 с.

PREMATURE CHROMOSOME CONDENSATION (PCC) ASSAY FOR PROTON BEAM THERAPY

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Premature chromosome condensation (PCC) method for analysis of the radiation-induced cytogenetic effects of the action of gamma rays and protons from a therapeutic fascicle beam at the entrance; and protons in the modified Bragg peak region on human peripheral blood lymphocytes (PBL) *in vitro*. The relationships were obtained by plotting the PCC-ring frequencies in PCC lymphocytes obtained by chemical induction with Calyculin A *in vitro*, with radiation doses between 0,5 to 2 Gy.

Keywords: premature chromosome condensation; Proton therapy; Relative biological effectiveness; chromosome aberrations; CABAS.

The induction of chromosomal aberration is one of the several biological responses to ionizing radiation which have been investigated as a means of estimating an individual's average whole-body dose. Biological dosimetry based on dicentric or micronuclei scoring in PBL after *in vitro* stimulation have the limitation of a low number of lymphocytes present in the blood after higher doses of ionizing radiation or experiencing mitotic delay. Thus, the scored mitoses might not be representative of the exposed cell population. The PCC technique is considered as a potent biodosimetric tool since it is the most sensitive method for analyzing the initial chromosome damage after irradiation. The PCC assay is useful to determine the exposure to low doses as well as following a life-threatening high acute dose of low and high LET ionizing radiation.

PCC most probably presents the only way in which the cytogenetic assessment of damages can be analyzed in special situations such as availability of limited numbers of sample cells and for cells which have lost their ability to divide.

The analysis of chromosome aberration in PBL is a sensitive and frequently applied method to assess the individual dose following accidental, occupational or medical exposure to ionizing radiation. According to standard protocol, lymphocytes are cultured *in vitro* for 12 h. Then, metaphases are harvested and chromosome aberrations are scored with the expectation that the data are representative of the whole cell population. However, it was shown that this protocol is not reliable in the case of high LET exposure. Protons induce a severe G2-arrest and the measurement of aberrations in metaphases at 12 h will result in very low RBE estimates, because heavily damaged cells are drastically delayed in their cell cycle and are not included in the analysis.

To overcome this problem, the measurement of aberrations in G2-cells collected at 12 h by chemically-induced PCC has been proposed.

To clarify this point we exposed lymphocytes of a healthy volunteer to protons or gamma-rays. Aberration yields were measured at 12 h measuring time in both first cycle G2-PCC and metaphase cells, and RBE values for the induction of 1 aberration per cell were derived.

Whole blood samples obtained from healthy donors were irradiated *in vitro*, with the ^{60}Co gamma-ray installation ROKUS-M, in a dose range from 0.5 to 2 Gy (dose rate 0.82 Gy/min), and with the synchrocyclotron therapeutic proton beam (Dzhelepov Laboratory of Nuclear Problems, JINR). Whole blood samples in the tubes were exposed to an unmodified proton beam entering the object with an energy of 150 MeV, the energy normally prepared for radiotherapy for patients. The dose rate was 1.3 Gy/min. In all experiments, cells were irradiated in a dose range from 0.5 to 2 Gy.

Culturing and fixation of human PBL was performed according to standard protocol recommended by the IAEA. The spectrum and the frequency of radiation-induced chromosomal aberrations of an unstable type was evaluated in the first post radiation mitosis (12 hours after the start of cultivation). Based on these results, the dose dependence of cells with chromosomal aberration formation and the total number of chromosomal aberrations in PBL under the influence of radiation *in vitro* has been found. Evaluation of the RBE of the therapeutic proton beam was conducted using the ratio of doses of proton and γ -radiation effects, at equal levels.

The curves of the frequency of unstable chromosomal aberrations have also been built using the CABAS software, which obtained curves that can be used as calibration curves for assessing dose in irradiated patients. It was shown that protons in the region of the Bragg Peak are more efficient in their damaging effects, while the effect of protons at the entrance is almost equivalent to the action of γ -rays.

BIBLIOGRAPHY

1. Tommasino, F. Proton Radiobiology / F. Tommasino, M. Durante // Cancers. – 2015. – Vol. 7. – P. 353–381.

STUDYING OF INDIVIDUAL TYPES OF SPECIFIC TOXICITY OF INNOVATIVE INFUSION SOLUTION FOR PARENTERAL NUTRITION BASED ON AMINO ACIDS

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Biomedical and, in particular, immunotoxic and allergenic properties of the domestic innovative infusion solution for parenteral nutrition based on a balanced composition of amino acids, mineral salts and antihypoxic components (hereinafter referred as AMG) were studied.

Keywords: immunotoxicity, allergenicity, hemagglutination reaction (HAR), delayed-type hypersensitivity reaction (DTHR), parenteral nutrition, amino acids.

The immunotoxic effect is traditionally understood as the modifying effect of xenobiotics and drugs on immunogenesis including immunosuppression and hyperstimulation of immunity, which can lead to a decrease in the resistance of the organism to infection, an increase in cancer risk, the development of autoimmune pathology and organism allergization. The main task of the preclinical study of the effect of potential medicines on the immune system is to prove or exclude the possibility of developing an immunotoxic action caused by a pharmacological agent or its metabolites in an animal experiment.

The objective is to study specific types of specific toxicity of an innovative infusion solution for parenteral nutrition based on amino acids AMG.