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THE HEALTH CONSEQUENCES OF THE CHERNOBYL CATASTROPHE

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The Chernobyl accident has caused the deposition of radioisotopes over very wide areas of the Northern Hemisphere, in particular in Europe [1], followed by chronic exposure of many millions of people to a mixture of external and internal radiation. However, the Republic of Belarus was affected by the accident more than any other country of the world. According to the Atlas of Caesium deposition on Europe practically the whole territory of Belarus was contaminated with different radioisotopes above the level of global fall-out. The deposition density with the isotope ^{137}Cs equal to 37 kBq/m^2 was chosen in the former USSR as an indicator of radioactive contamination. In Belarus approximately 23% of the territory were contaminated with this isotope to the level equal to 37 kBq/m^2 or higher.

The United Nations Chernobyl Forum issued in 2006 under the aegis of WHO the report “Health Effects of the Chernobyl Accident and Special Health Care Programmes” that analyzed results of studies of the environmental and health consequences of the Chernobyl accident that were performed in last 20 years. The report confirmed manifestation of radiation-induced thyroid cancer in those exposed in childhood and adolescence and concluded that no increase occurred in the incidence of other cancers and congenital malformations that can be attributed to radiation exposure. In reality, the report repeated the conclusions drawn by the UNSCEAR “2000 Report to the General Assembly, Annex J, Exposures and the Effects of the Chernobyl Accident”. It is intriguing to note that prognosis estimate of fatal cases due to the Chernobyl is much less in Joint News Release WHO/IAEA/UNDP “Chernobyl: the true scale of the accident; 20 years later a UN report provides definitive answers and ways to repair lives” and the report’s 50-page summary in comparison with the report of the Chernobyl Forum.

There are at present a lot of reliable data that allows drawing quite other conclusion about health effects of the Chernobyl accident than conclusions made in above-mentioned reports.

A number of studies conducted during the past two decades give reliable data about serious biological and medical effects of the Chernobyl accident and about harmful impact of irradiation at low doses and low dose rates. Such results were established for cell, animals and human. According to our own results irradiation at doses less than 10 cSv (less than 100 mSv) causes serious effects in somatic and germ cells of a model mammalian species (bank vole). These results

were established by study 22 generations of bank voles chronically exposed to low doses of ionizing radiation within 10 years following the Chernobyl accident [2]. The analysis of our and literature data shows that the doubling dose estimates for acute irradiation of somatic cells of bank vole and human lymphocytes as well as germ cells of laboratory mice are close to each other [3]. Therefore, the choice of bank voles as a model species for assessing radiation genetic risk is justified.

On the other hand, the recent report on solid cancer incidence in atomic bomb survivors in the period 1958—1998 years [4] and other publication of the Radiation Effects Research Foundation (RERF) specialists [5] have presented statistically significant evidence of radiation risk in atomic bomb survivors in the dose range of 0–0.15 Gy. The whole body doses received by exposed populations of the Republic of Belarus, Ukraine and contaminated regions of the Russian Federation are estimated to be in this range, i. e. within the range that led to a reliable manifestation of additional cancers in survived inhabitants of Hiroshima and Nagasaki. Although the investigations of the RERF specialists are often considered as the high-dose researches, in reality, approximately 30% of the exposed individuals of the observed cohort of atomic bomb survivors received doses from 5 to 200 mGy [4]. Such doses of the whole body irradiation were delivered as a result of the Chernobyl accident to inhabitants of high-contaminated areas in Belarus, Ukraine and Russia too. This indicates the possibility of radiation-induced cancers caused by the Chernobyl accident. It is important to note that radiation-related cancers at low doses among survivors were established later than in the range of high doses. The longer latency period in case of low doses of irradiation is responsible for this effect. Thus, one needs to expect more pronounced manifestation of additional cancers from the Chernobyl accident in the future time. Particularly, dose dependent three fold increa-se of breast cancer incidence was recently shown for women of Gomel region [6].

It is evident that for establishing the causal role of low dose radiation exposure due to the Chernobyl fallout for the observed increases of many types of cancer and congenital malformations in Belarus [6], long-term radiation-epidemiological studies with reconstruction of whole body absorbed doses must be carried out in the future. Recent cellular and molecular studies have shown different radiation effects such as induced genomic instability, bystander effect and a complex transcription response. Transgenerational accumulation of radiation damage over 22 animal generations was found in bank vole populations chronically exposed to low doses delivered with very low dose-rates [2, 7]. Evidently, non-targeted effects of ionizing radiation such as genomic instability, bystander effects and other new phenomena have to contribute to short-term and long-term overall health effects in human after low dose of ionizing radiation. In this respect we perform study of a genomic instability of different risk groups in Belarusian population [8]. We suppose earlier that increased thyroid cancer incidence of children born from irradiated parents chronically exposed due to Chernobyl accident might be a manifestation of the induced genomic instability [9].

There is a set of data on inverse radiation dose-rate effects on somatic and germ cells to low radiation doses [10]. We have shown inverse radiation dose-rate effects [DRE] on somatic mutations of bank voles chronically exposed to the Chernobyl fallout [3]. Direct comparison between the genetic efficiencies of low dose-rate chronic irradiation and higher dose-rate acute irradiation was carried out in natural populations of bank vole that inhabited two sites in Belarus differing in radionuclide ground deposition. Low doses of chronic irradiation have been about ten times more effective than those of acute irradiation. The same fact can be expressed by the doubling doses. The doubling dose value was 2.61 cGy in case of the low dose-rate chronic exposure and 31.6 cGy in case of the acute irradiation. There is also similar data concerning cancer risks attributable to low doses. The estimated excess relative risk (ERR) per Sv for the selected dose ranges of Life Span Study cohort was the highest for the lowest dose category, namely from 5 to 20 mSv [5].

Recently, the scientists of the RERF gave reliable evidences of radiation effects on noncancer mortality. Statistically significant increases are seen for heart diseases, stroke, digestive, respiratory and other diseases [11].

Summing up all these data allow us to conclude that the accident at the Chernobyl nuclear power plant will result in a number of unfavorable health consequences for both affected people and coming generations. Thus, the conclusions of the report of the UN Chernobyl Forum are misleading.

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