The scientific basis for the organization of health screening radiation-exposed population of Kazakhstan, the results of the analysis, design prenosological prevention and rehabilitation

T. Muldagaliev, M. Hoshi, R. Apsalikov, N. Kawano, T. Belihina.
Institute of Radiation Medicine and Ecology, Ministry of Health of RK, Semey, Kazakhstan.
muldagaliev@mail.ru

Introduction

Health effects of the Semipalatinsk nuclear test site are not limited to the purely radiological. Experience of the elimination of the Chernobyl disaster, the Ural region of Semipalatinsk Nuclear Test Site (SNTS) suggests that minimizing the effects of radiation exposure for the population depends on the organization and effective work of agencies and health institutions.

In this regard, one of the major tasks of medical care is still a timely organization of clinical and epidemiological surveillance of the health of people living in the disadvantagedly radioecological areas. Thus obtained and strictly verified operational information from the medical and scientific research institutions of the country about the health of the population, who had been exposed to ionizing radiation is the main criterion for the mobilization of additional forces and resources for healthcare assistance to victims of disasters and radioecological consequences of the development of radiation protection measures.

Priority actions in the health care of this population are in the competence of the government. These actions demand for the creation of a national system of control measures in health care.

In this regard, the priority development of activities of practical public healthcare in affected areas as well as medical health care of affected people remains long-term goal of the state.

Materials and Methods

From the list of representatives of the population of Borodulikha, Beskaragai and Kokpekty areas of East-Kazakhstan District included in database as of 2006 -2010 years, were formed by two representative groups for the study of epidemiological and statistical analysis of the prevalence of morbidity - the main group is the primary medical records – 3,130 people and a control group (Kokpekty District) – 1,988 people.

In assessing the dynamics of the level of disease prevalence rate PR is calculated by the formula:

$PR=n \times 10^{3} /N,$

where n - number of persons suffering from this disease at a certain time (at the time of the survey), N-size of the cohort during the inspection, 10^{3}- the standard number of surveys.

To characterize the prevalence of diseases were calculated by the intensive parameters. To eliminate the influence of demographic differences we performed subsequent standardization of these indicators in direct way by conventional methods in medical statistics.

As an indicator on the differences in prevalence among groups selected areas as a whole, separate age-sex groups, using the value of the indicator "relative comparison" - the relative risk [11].

RR=PR of the main group / PR control group A statistically significant increase in relative risk was confirmed by constructing 95% confidence intervals. Statistical significance was assessed using the RR criterion χ 2, percentage points of distribution are given in tabular form in handbooks on statistics. To investigate the relationship between the discrete qualitative characteristics were analyzed by two-dimensional contingency tables with calculation of the values of Pearson χ 2 and the values of the association ϕ - index of the coupling strength for the qualitative dichotomous variables [12].

Results and discussion

Table 1 presents data on average annual values of the levels of prevalence of diseases with a significant difference between study and control groups. The average level of general morbidity among men and women made up the core group – 2,620.9cases per 1000 population in the control group – 1,631,0 (RR = 1,59, p <0.05).

It has been established that the highest relative risks in the study group were recorded on diseases of blood and hematopoietic system, endocrine system diseases, mental disorders, diseases of the digestive system, and inborn malformations. Average annual rates of cancer in the study group were - 260, 0 cases per 100 000 population, in the control group - 170. 0 cases (RR = 1, 53, p <0.05). Approximately the same relative risks reported for diseases of the circulatory system (1.54) and diseases of the respiratory system (1.55). The average levels of blood diseases and blood-forming tissue in the study group were - 161.4 per 1,000 population, in the control group - 78.3 cases (RR = 2, 06, p <0.01). Average annual rates of diseases of the endocrine system (the average proportion of thyroid diseases - 74.2%) in the study group was - 278.4 per 1,000 population in the control group - 126.8 cases (RR = 2, 37, p <0, 05). The highest average levels of illness in the study group reported on diseases of the circulatory system (CVD) and respiratory system. Thus, the average level of CVD in the study group was -690.2 per 1,000 population, in the control group - 467, 3 (RR = 1, 54, p <0.05). The average relative risk of diseases of the respiratory system in the study group was - 1.55.

These results testified to the sound methodological approach to the organization of screening in populations living in disadvantaged radioecological areas. First of all, it is relate to the careful selection of representative groups of research before the actual screening.

The proposed system of surveys of screening radiation risk groups in areas adjacent to SNTS is a complex joint actions of Institute of Radiation Medicine and Ecology of the city of Semey and Family and health facilities explored regions taking into account the forming of study groups (with confirmation of legal residence in a particular locality), forecasting, early diagnosis and preventive treatment of radiation-induced diseases.

As the analysis of domestic, foreign literature and research results among the liquidators of the Chernobyl accident and those living in the contaminated areas shows that there is an increased dosoindependent incidence of cardiovascular and cerebrovascular pathology.

In large-scale epidemiological studies conducted on populations exposed to radiation in different radioecological situations, significant differences are not found in the dynamics of morbidity among individuals with different dose rates compared with expected. They did not register "dose-effect" as well.

Therefore, we must recognize that only a standardized screening methods based on the formation of

groups of radiation risk, taking into account the objective dose rates, will provide data on the prevalence and nature of somatic pathology of the decreed population, to assess the needs in the location of specialized medical care that can improve the quality of life of people affected due to the testing of nuclear weapons.

We believe the most effective study of markers indicating radiation damage and elucidation of the pathogenetic mechanisms of radiation-induced somatic pathology not only in a hospital survey, but also in the results of primary screening of the health of the affected population from nuclear weapons tests in the SNTS.

Experience of Clinical Research departments of Radiation Medicine and Ecology in the last 10 years including studying and assessing the health of the irradiated population of Kazakhstan, allowed to formulate the main stages of screening.

The First step: the creation of the office-based medical statistics of regional medical hospitals of the database of the State Scientific-aided medical register affected by the Semipalatinsk nuclear test site (SNTS).

The tasks of database sector:

-monitoring of decreed population movement in the group;

-monitoring of health status decreed by the group;

-verification and ranking the causes affecting the health of the population of the decreed group;

-the formation of groups at risk the implementation of long-term effects of radiation;

-formation of the limited volume of care of the decreed population;

The second stage – the organization of medical assistance to affected populations

Objectives of the second stage:

Planning and allocation amounts of medical services between partners required to meet the challenges of early diagnosis and in-depth survey of the decreed population;

-negotiation and approval of schedules of joint activities for the conducting routine inspections of the decreed population;

-organization of joint preventive examinations of the decreed population;

-organization of in-depth survey using consultative and diagnostic department of Institute of Radiation Medicine and Ecology;

-organization of treatment of identified patients in the hospital of the Research Institute of Radiation Medicine and Ecology, and regional hospitals.

The third phase – the development of risk criteria and methods of radiation-induced diseases, treatment and prevention of long-term effects of radiation.

Objectives:

-analysis of information on the movement of people and the main statistical indicators of the health of radiation-exposed population and their descendants;

-study of pathogenetic mechanisms of inheritance and implementation of long-term effects of irradiation descendants of persons born to parents exposed to radiation;

-the introduction of methods of early diagnosis, treatment and prevention of radiation-induced diseases.

Currently, the Institute of Radiation Medicine and Ecology widely uses epidemiological methods of

calculation of phenotypic correlations ("parent-child") of individual nosological forms of diseases, established in individuals exposed to direct radiation and their possible inheritance when radiation-induced modification of the genome of their offsprings.

The Institute's specialists developed an algorithm for the possible pathogenetic mechanisms of indirect effects of radiation exposure in high-risk groups, represented by the descendants of those born to exposed parents, early diagnosis prenosological states, monitoring of risk factors for primary prevention (Figure 1).

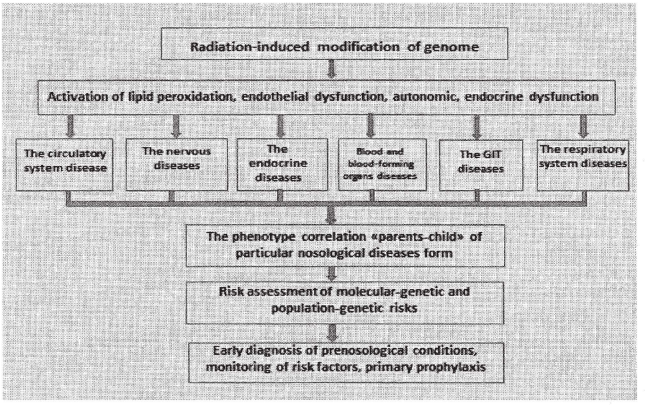

Figure 1 - The system of forecasting, early detection, prevention and treatment of radiation risk in groups of children born to exposed parents

Modern cytogenetic and molecular genetic studies of radiation risk groups of the participants in the elimination of the Chernobyl accident, and also decreed population led to the "breakthrough" in science conclusions about the pathogenic mechanisms of radiation-induced modification of the human genome, are realized in the form of genomic instability (clinical interpretation), followed by inheritance of individual deterministic effects of ionizing radiation.

Radiogenic modification of the genome associated with activation of lipid peroxidation, endothelial disfunction, impaired autonomic regulation and hormonal imbalance homeostat. These targets form the radiation exposure of individual clinical features of the current nosological forms of diseases associated with the earlier they start, malignant course, the frequency of complications and their outcomes. These pathological substrates in radiogenic modification of the genome are inherited and recorded.

The presented scheme of development and implementation of the pathogenetic mechanisms of radiation-induced modification of the genome requires amolecular-genetic objectivization with subsequent calculation of risk. We believe that only the early diagnosis prenosological forms of disease in groups of children born to parents exposed to radiation, monitoring of risk factors, as well as primary prevention, may confirm or refute the possibility of inheritance of determinate ionizing radiation parents of their children.