Screening and monitoring of main diseases – a modern strategy of health maintenance in personnel of radiation dangerous plants

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Abstract. Population health is greatly determined by social factors, mode of life, ecological situation, amount and quality of medical assistance. The analysis of reasons of health troubles increase in population should be done taking into account the above aspects. Main consideration should be given to the development of measures aimed at the highest possible decrease of technogenic and anthropogenic factors influence on a human. Thereupon a complex programme of main diseases screening and monitoring in the personnel of the Siberian Group of Chemical Enterprises (SGCE) to be the biggest one among Russian atomic plants has been developed. The purpose of the present paper is to determine main diseases at the earliest stage, the decrease of death rate, as well as the complex estimation of technogenic factors influence on the personnel of radiation dangerous plants and their offsprings. In this case a long-term effect of low doses seems to be the main risk factor. Taking into account the structure of death rate causes of the population of industrialized countries as well as the spectrum of stochastic effects of ionizing radiation, the screening of cardiac ischemia and arterial hypertension, localization of cancer and congenital malformations have been chosen as the program priorities. Algorithm of instrumental laboratory screening of a particular disease includes modern diagnostic tests. Groups at risk are formed taking into account a complex of exogenous and endogenous risk factors (age, chronic diseases, bad habits, length of service at a radiation dangerous plant, dose loads, hereditary factors) and on the basis of the screening examination results. The information obtained is entered in the list of database of the Regional Medicodosimetric Register of the SGCE personnel and Seversk residents followed by analysis and monitoring of groups at risk.

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By the development of modern strategy of public health maintenance it is necessary to take into account the structure of morbidity and mortality rate, their tendencies in a definite group of people as well as the main factors that can influence on the occurrence and development of main diseases.

At present a steady tendency to the increase in morbidity rate with non-infectious diseases is recorded in industrialized countries worldwide. Among the death causes cardiovascular and cancer diseases prevail.

The problem of increased morbidity rate with malignant neoplasms is of great importance. In spite of new methods developed to reveal and treat cancer diseases the situation is of no change. An overwhelming majority of sick people with a primary established diagnosis of malignant neoplasm (especially those with visceral localization) have locally advanced or generalized tumour process that causes a high rate of one-year mortality and low rate of five-year survival. Taking into account a tendency of cancer diseases occurrence in younger age and the expenses necessary to treat patients using up-to-date high-tech methods it is obvious that the problem of treating cancer diseases is no more a medical problem but is of a universal character touching both economical and social spheres of life.

All mentioned above refers to cardiovascular diseases as well. According to the WHO data arterial hypertension and ischemic heart disease make up 35% of all cardiovascular diseases. About 38 mln.
people in Russia suffer from arterial hypertension, among them only 10% are under medical supervision and only half of these patients get proper treatment [1]. Taking into account the amount of sick people, the expenses necessary for treatment, the range of complications (complications proper and those which are the death causes), social loss the postulate about the priority and life necessity to realize the principle of prevention proves to be indisputable which is based on the objective views of etiological factors of a particular disease development [2] as well as pathogenetic aspects and organism manifestations.

The development and realization of integrated programs to prevent main diseases (primarily cancer and cardiovascular ones) imply some conditions, namely: understanding of the necessity to perform preventive measures (based on the objective views of epidemiological situation and its dynamics relating to a particular disease or a group of diseases in the world, country, particular region or town); high-skilled medical staff and up-to-date diagnostic and medical equipment; adequate competence of population concerning the degree of problem significance; particular cultural level of the society that provides for the priority of health preserving, its maintenance and improvement.

An ideal object to implement the program of preventive measures seems to be a restricted group of population where it is possible to determine the risk factors of a disease development, creation of a proper objective view about the tendencies of its spreading etc.

The personnel of the Siberian Group of Chemical Enterprises (SGCE) to be the biggest one among the atomic power plants in the world was taken as a population group.

The given population is of great interest from the point of view of objective evaluation of the diseases prevalence mentioned above. Among the risk factors of the above diseases one should mention ionizing radiation that can influence on the SGCE personnel during their occupational activities (external, internal, combined radiation). Screening on timely revealing the initial stages of malignant neoplasms in the given population is justified not only from the point of view of survival index improvement but allows us to estimate the risk of diseases development depending on the degree of radiation factor influence (dose load) [4]. It is necessary to note that at the SGCE there were no situations connected with personnel exposure higher than the norms in cases of radiation incidents or accidents. Thus, taking into account the situation of long-term radiation influence factor we deal with evaluation of radiation influence within the range of low doses. Developing the system of malignant neoplasms screening we took into account not only the role of ionizing radiation in the development of leukosis and some solid tumours but the structure of neoplasms characteristic of the population of the given territory as well.

Thereupon the following localizations of malignant neoplasms were chosen as the object of screening: for males – lung cancer, gastric cancer, prostate cancer; for females – breast cancer, gastric cancer.

The developed methods for screening measures provide for diagnostic measures based on the following scheme.

In case of lung cancer all SGCE workers must undergo fluorography examination during annual preventive examination. Further examination must be done in different groups of workers taking into account occupational activities (for example, the workers of the plutonium production have Pu accumulation in the lungs by inhalation intake in an organism), determined risk factors (smoking), age factor (40 and older), case history data (chronic bronchitis longer than 10 years, chronic pneumonia), hereditary factors (cases of lung cancer in blood relatives). It is necessary to perform annual cytological examination of sputum (5 times) to reveal atypical cells or lung cancer in people with a combination of at least two factors mentioned above. In case of any disturbances revealed the given group should be referred to the group under risk and it is necessary to perform the whole complex of specific diagnosis (X-ray examination, tomography, fibrobronchoscopy etc.)

In case of gastric cancer the initial stage is to form the groups under risk according to the following criteria: age 40 and over, chronic atrophic hyperplastic gastritis in case history (longer than 5 years) or
some other chronic diseases of the stomach accompanied by epithelium dysplasia of the mucous membrane of the stomach of II-III stage, hereditary predisposition (blood relatives with gastric cancer, Lynch syndrome, Gardner syndrome), bad habits (smoking). The next stage includes fibrogastroscopy of all persons under risk with biopsy from all parts of the stomach (minimum 3 samples from each part). The above method was approved in 178 persons under risk on the basis of a polyclinic in Tomsk. Diagnostic measures in the given group were performed for 2 years. Gastric cancer was revealed in 14 patients (including 10 persons with I-II stage, 2 – with cancer of papilla duodeni major, 1 – with cancer of the right half of the large intestine). Almost all patients did not have any clinical symptoms at the moment of cancer diagnosis.

In case of prostate cancer all males over 40 should be examined. The method of screening examination implies finger examination of the rectum, ultrasonic examination of the prostate and determination of PSA level. Persons with disturbances undergo thorough examination including aiming puncture biopsy of the prostate. The above method was approved in SGCE personnel, performed by the specialists of the Tomsk Cancer Research Institute and proved to be effective.

In case of breast cancer all females irrespective of age should undergo examination. More attention should be paid to the group aged 40-45 and over or those with breast diseases (fibroadenoma, fibrocystic mastopathy accompanied by the disturbances in epithelium proliferation). Depending on the age instrumental screening implies the performance of mammography or ultrasonic examination of the breast. In case of pathologic (structural) disturbances it is necessary to perform puncture biopsy.

A necessary condition to realize the program of malignant neoplasms screening seems to be the amount of obtained information to be entered the database of the Regional Medicodosimetric Register (RMDR) of SGCE personnel. The above database includes information on life and occupational status (passport data, data on occupational activities, dose loads, hereditary information, data on morbidity rate etc.) of all SGCE workers. All cases of malignant neoplasms revealed are filled in the register on cancer diseases being the structural element of RMDR. To store the information within a unified database allows us to perform a thorough screening of groups under risk as well as analyze the correlation between the malignant neoplasms with different factors influence, mainly, ionizing radiation within the range of low doses. To perform the above analysis on a population level will allow us to obtain the objective view of malignant neoplasms risk at long-term influence of ionizing radiation at low doses.

The necessity to join the program on cardiovascular diseases screening was caused by the results of analyzing the dynamics of morbidity and mortality rate for acute myocardial infarction of SGCE personnel and Seversk residents (not involved in occupational activities connected with ionizing radiation). The data obtained testify to the fact that morbidity rate with acute myocardial infarction among SGCE workers is higher than that one among residents. Among SGCE personnel the highest morbidity rate with acute myocardial infarction is recorded in workers of the main production (involved in activities with sources of ionizing radiation). (Fig.1).

For the period 1998-2002 the morbidity rate among population increased on the whole (from 2,55 to 3,2 per 1,000 residents in 1998-2002, respectively). The increased morbidity rate was recorded in both groups (among SGCE personnel and residents) that corresponds to general tendencies of morbidity rate with acute myocardial infarction on the territory of the Russian Federation. The morbidity rate among workers (3,73-4,92-4,71-5,05-4,59) exceeded the morbidity rate among residents (2,18-2,18-2,3-2,46-2,73, p<0,0001); the morbidity rate with acute myocardial infarction in a group of SGCE personnel exposed to ionizing radiation at the work places exceeded similar figures at the enterprise on the whole (4,19-5,82-6,44-5,61-3,95 per 1,000, p=0,294).

According to the data of official statistics, diseases of blood circulation system occupy the first position within the structure of mortality rate of SGCE personnel for the last five years and they tend to increase (51% and 58% in 1999 and in 2002, respectively). The initial disablement of the workers for cardiovascular diseases increased. In spite of annual medical examinations they cannot be
considered as satisfying to the up-to-date demands. Insufficient efficiency of available methods to perform mass preventive examinations is caused by the following factors:

- performance of initial diagnostics (as well as determining the amount of diagnostic procedures) on the basis of the patients’ complaints. However, SGCE workers try not to complain because of fear of a disease to be diagnosed and as a consequence to be dismissed from the main production and lose salary;

- application of low-informative out-of-date algorithms of diagnosis (sets of diagnostic tests);

- impossibility to perform highly informative diagnostic procedures to all persons under supervision (as a consequence of insufficient equipment or its absence).

Thereupon, we attempted to develop and realize a complex of measures within the second prevention of acute coronary events taking into account a particular group of personnel with a particular occupational insalubrity.

Application of standard epidemiological methods in 2000 allowed us to examine 108 males aged 30-59 (that makes up 78% of the whole personnel of a particular department). They were in good health condition according to the data of previous annual medical examinations. The average age in the group was 46.2±1.5. Cardiologic screening included a common epidemiological record to reveal cardiovascular diseases and risk factors (a usual medical questioning based on Rose questionnaire, anthropometric examination, medical examination, electrocardiogram at rest, eye-ground test, biochemical blood test to determine lipid spectrum). Blood pressure was measured twice with 3-5 min. intervals [3]. Arterial hypertension was evaluated according to the criteria of experts of the Scientific Society of Arterial Hypertension, the Russian Scientific Society of Cardiologists and the
Interdepartmental Council for Cardiovascular Diseases. A standard register of epidemiological research was completed by up-to-date methods of research: postloading, stress echocardiography in combination with veloergometry and/or Halter monitoring of electrocardiogram, angioscanning of the carotid femoral arteries performed on the basis of standard methods [1]. To diagnose occult coronary deficiency we used stress echocardiography. A test with measured physical load was chosen as stress-load. The test was considered as a positive one according to the standard electrocardiographic and ultrasonic criteria. A positive result of the load test was approved after load perfusion scintigraphy of the myocardium with thallium-99 on the basis of the Cardiology Research Institute of the Tomsk Scientific Centre of the Siberian Branch of the Russian Academy of Medical Sciences. An extended volume of research was conditioned by a necessity to specify the possibility of every person involvement in harmful and dangerous conditions.

Analyzing the results of a clinical stage of screening it should be noted that only 16% of the examined persons complained of cardiologic pains. Episodes of mild and moderate arterial hypertension were noted in 52% of workers but they did not estimate them as pathology. Approximately 18% of workers suffered from obesity; every second was a tobacco smoker. Pathologic shifts of the lipid spectrum were revealed in 38% of people under examination, tendency to hypercoagulation was observed in every tenth male. Hereditary aggravation for cardiovascular diseases was revealed in 30% of patients.

True prevalence of arterial hypertension under strict criteria (blood pressure > 140/90 mmHg) made up 67.8% of the examined persons. At the age under 50 there were more healthy persons than those with arterial hypertension. Among persons aged 50-59 the amount of patients suffering from arterial hypertension exceeded healthy people by 2.7 times. With increasing the age the amount of patients with arterial hypertension raised: in the first two groups (aged 30-39 and 40-49) every third male suffered from hypertension, at the age over 50 arterial hypertension was diagnosed in 84% of the examinees. The amount of patients with arterial hypertension of I stage made up 7.4% among examined, II stage – 76.2%, III stage – 13.4%.

In the result of the performed screening research ischemic heart disease was revealed for the first time in 9.6% of examinees. It should be noted that ischemic heart disease occurring at the pick load was painless in most patients which is indisputably a factor complicating diagnostics of occult coronary insufficiency and aggravating prognosis.

The work within the framework of cancer and cardiologic screening includes the collection of biological samples (blood) to isolate DNA and perform molecular genetic research on detection of genetic conditionality of disease development in conditions of chronic exposure as the risk factor.

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