



**COMPLEMENTATION OF MORPHO-FUNCTIONAL CHANGES IN THE
HEART UNDER THE INFLUENCE OF CHRONIC RADIATION WITH
BIOLOGICALLY ACTIVE SUPPLEMENTS**

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Sultonova Lola Dzhakhonkulovna

Bukhara State Medical Institute

doctor of medicine, associate professor.

Sherov Jakhongir Akbarovich

Republican specialized cardiology scientific and practical medical center,

regional branch of Samarkand region

ANNOTATION

This article examines the incidence of cancer, as well as the specific clinic of chronic radiation for their treatment, morphofunctional changes in the heart caused by chronic radiation, as well as modern research methods.

Keywords

medicine, morphology, oncology, cardiologists, radioprotective agents, radionuclides, chloroform.

Radiation sickness is a complex of general and local reactive changes caused by the effect of increased doses of ionizing radiation on cells, tissues and body environments. Radiation sickness occurs with the phenomena of hemorrhagic diathesis, neurological symptoms, hemodynamic disorders, a tendency to infectious complications, gastrointestinal and skin lesions. Diagnosis is based on the results of dosimetric monitoring, characteristic changes in the hemogram, biochemical blood tests, and myelogram. In the acute stage of radiation sickness, detoxification, hemotransfusion, antibiotic therapy, and symptomatic therapy are performed.

Radiation sickness is a common disease caused by the effect of radioactive radiation on the body in a range exceeding the maximum permissible doses. It occurs with damage to the hematopoietic, nervous, digestive, skin, endocrine and other systems. Throughout life, a person is constantly exposed to low doses of ionizing radiation coming from both external (natural and man-made) and internal sources that penetrate the body during breathing, water and food consumption and accumulate in tissues. A., with a normal radiation background, taking into account the above-mentioned factors, the total dose of ionizing radiation usually does not exceed 1-3 mSv (mGr) /year and is considered safe for the population. According



to the conclusion of the International Commission on Radiological Protection, radiation sickness may develop if the exposure threshold is exceeded by more than 1.5 Sv/year or a single dose of 0.5 Sv is received.

Causes of radiation sickness

Radiation damage may occur due to single (or short-term) exposure to high intensity or prolonged exposure to low doses of radiation. Damaging effects of high intensity are typical for man-made disasters in nuclear energy, testing or use of nuclear weapons, total radiation in oncology, hematology, rheumatology, etc. Chronic radiation sickness can develop in medical personnel of radiological and therapeutic departments (radiologists, radiosurgeons), patients undergoing frequent radiological and radionuclide studies.

Damaging factors can be alpha and beta particles, gamma rays, neutrons, X-rays; simultaneous exposure to various types of radiation energy is possible - the so-called mixed irradiation. At the same time, neutron flux, X-ray and gamma radiation can cause radiation sickness when exposed externally, whereas alpha and beta particles cause harm only when they enter the body through the respiratory or digestive tract, damaged skin and mucous membranes.

Radiation sickness is the result of damaging effects occurring at the molecular and cellular level. As a result of complex biochemical processes, products of pathological fat, carbohydrate, nitrogen, water-salt metabolism appear in the blood, causing radiation toxemia. The damaging effects primarily affect actively dividing cells of the bone marrow, lymphoid tissue, endocrine glands, intestinal and skin epithelium, and neurons. This causes the development of bone marrow, intestinal, toxic, hemorrhagic, cerebral and other syndromes that make up the pathogenesis of radiation sickness.

The peculiarity of radiation damage is the absence at the time of direct exposure to heat, pain and other sensations, the presence of a latent period preceding the development of a detailed picture of radiation sickness.

The classification of radiation sickness is based on the criteria of the time of injury and the dose of absorbed radiation. With a single massive exposure to ionizing radiation, acute radiation sickness develops, with prolonged, repeated in relatively small doses, chronic radiation sickness. The severity and clinical form of acute radiation injury are determined by the radiation dose:

Radiation injury occurs with simultaneous / short-term irradiation with a dose of less than 1 Gy; pathological changes are reversible.

The bone marrow form (typical) develops with simultaneous / short-term irradiation with a dose of 1-6 Gy. The mortality rate is 50%. It has four degrees:

- 1 (light) - 1-2 G
- 2 (medium) - 2-4 G

- 3 (heavy) – 4-6 G
- 4 (extremely heavy, transitional) – 6-10 G

The gastrointestinal form is the result of simultaneous / short-term irradiation with a dose of 10-20 Gy. It occurs with severe enteritis, bleeding from the gastrointestinal tract, fever, infectious and septic complications.

The vascular (toxemic) form manifests itself with simultaneous / short-term irradiation with a dose of 20-80 Gy. It is characterized by severe intoxication and hemodynamic disorders.

The cerebral form develops with simultaneous / short-term irradiation with a dose of more than 80 Gy. The fatal outcome occurs 1-3 days after irradiation from cerebral edema.

The course of the typical (bone marrow) form of acute radiation sickness passes through the IV phase:

- I - phase of primary general reactivity – develops in the first minutes and hours after radiation exposure. It is accompanied by malaise, nausea, vomiting, arterial hypotension, etc.
- II - latent phase – the primary reaction is replaced by an imaginary clinical well-being with an improvement in the subjective state. It starts from 3-4 days and lasts up to 1 month.
- III - phase of the developed symptoms of radiation sickness; occurs with hemorrhagic, anemia, intestinal, infectious, etc. syndromes.
- IV – recovery phase.

Chronic radiation sickness in its development goes through 3 periods: formation, recovery and consequences (outcomes, complications).

The period of formation of pathological changes lasts 1-3 years. During this phase, a clinical syndrome characteristic of radiation damage develops, the severity of which can vary from mild to extremely severe. The recovery period usually begins 1-3 years after a significant decrease in intensity or complete cessation of radiation exposure. The outcome of chronic radiation sickness may be recovery, incomplete recovery, stabilization of the changes or their progression.

In typical cases, radiation sickness occurs in the bone marrow form. In the first minutes and hours after receiving a high dose of radiation, in the first phase of radiation sickness, the victim experiences weakness, drowsiness, nausea and vomiting, dryness or bitterness in the mouth, headache. With simultaneous irradiation at a dose of more than 10 Gy, fever, diarrhea, arterial hypotension with loss of consciousness may develop. Local manifestations may include transient erythema of the skin with a bluish tinge. On the part of peripheral blood, early changes are characterized by reactive leukocytosis, which is replaced by leukopenia



and lymphopenia on the second day. The absence of young cell forms is determined in the myelogram.

In the phase of apparent clinical well-being, the signs of the primary reaction disappear, and the victim's well-being improves. However, an objective diagnosis determines the lability of blood pressure and pulse, decreased reflexes, impaired coordination, and the appearance of slow rhythms according to EEG data. Baldness begins and progresses 12-17 days after radiation damage. Leukopenia, thrombocytopenia, and reticulocytopenia are increasing in the blood. The second phase of acute radiation sickness can last from 2 to 4 weeks. With an irradiation dose of more than 10 Gy, the first phase can immediately pass into the third.

In the phase of pronounced clinical symptoms of acute radiation sickness, intoxication, hemorrhagic, anemic, infectious, skin, intestinal, and neurological syndromes develop. With the onset of the third phase of radiation sickness, the condition of the victim worsens. At the same time, weakness, fever, and hypotension increase again. Against the background of deep thrombocytopenia, hemorrhagic manifestations develop, including bleeding gums, nosebleeds, gastrointestinal bleeding, hemorrhages in the central nervous system, etc. The consequence of damage to the mucous membranes is the occurrence of ulcerative necrotic gingivitis, stomatitis, pharyngitis, gastroenteritis. Infectious complications of radiation sickness most often include sore throats, pneumonia, and pulmonary abscesses.

With high-dose radiation, radiation dermatitis develops. In this case, primary erythema forms on the skin of the neck, elbow bends, axillary and inguinal areas, which is replaced by swelling of the skin with the formation of blisters. In favorable cases, radiation dermatitis resolves with the formation of pigmentation, scars and thickening of subcutaneous tissue. When the vessels are interested, radiation ulcers and skin necrosis occur. Hair loss is common: hair removal on the head, chest, pubis, loss of eyelashes and eyebrows is noted. In acute radiation sickness, there is a deep inhibition of the function of the endocrine glands, mainly the thyroid gland, gonads, and adrenal glands. In the long-term period of radiation sickness, an increase in the development of thyroid cancer was noted.

Gastrointestinal tract damage can occur in the form of radiation esophagitis, gastritis, enteritis, colitis, hepatitis. At the same time, nausea, vomiting, pain in various parts of the abdomen, diarrhea, tenesmus, blood admixture in feces, jaundice are observed. The neurological syndrome accompanying the course of radiation sickness is manifested by increasing adynamia, meningeal symptoms, confusion, decreased muscle tone, increased tendon reflexes.

During the recovery phase, well-being gradually improves, and impaired functions are partially normalized, however, anemia and asthenovegetative



syndrome persist in patients for a long time. Complications and residual lesions of acute radiation sickness may include the development of cataracts, cirrhosis of the liver, infertility, neuroses, leukemia, malignant tumors of various localizations.

Chronic radiation sickness

In the chronic form of radiation sickness, the pathological effects unfold more slowly. The leading ones are neurological, cardiovascular, endocrine, gastrointestinal, metabolic, and hematological disorders.

Mild chronic radiation sickness is characterized by nonspecific and functionally reversible changes. Patients feel weakness, decreased performance, headaches, sleep disorders, and an unstable emotional background. Among the constant signs are decreased appetite, dyspeptic syndrome, chronic gastritis with reduced secretion, biliary dyskinesia. Endocrine dysfunction in radiation sickness is expressed in a decrease in libido, menstrual disorders in women, impotence in men. Hematological changes are unstable and not pronounced. The course of mild chronic radiation sickness is favorable, recovery without consequences is possible.

With an average degree of radiation damage, more pronounced vegetative-vascular disorders and asthenic manifestations are noted. Dizziness, increased emotional lability and excitability, memory loss, and possible bouts of loss of consciousness are noted. Trophic disorders are added: alopecia, dermatitis, nail deformities. Cardiovascular disorders are represented by persistent arterial hypotension, paroxysmal tachycardia. Hemorrhagic phenomena are characteristic of the II degree of severity of chronic radiation sickness: multiple petechiae and ecchymoses, recurrent nasal and gingival bleeding. Typical hematological changes are leukopenia, thrombocytopenia; in the bone marrow - hypoplasia of all hematopoietic growths. All changes are persistent.

Severe radiation sickness is characterized by dystrophic changes in tissues and organs that are not compensated by the regenerative capabilities of the body. Clinical symptoms are progressive, intoxication syndrome and infectious complications, including sepsis, are additionally added. There is a sharp asthenization, persistent headaches, insomnia, multiple hemorrhages and repeated bleeding, loosening and loss of teeth, ulcerative necrotic changes in the mucous membranes, total baldness. Changes in peripheral blood, biochemical parameters, and bone marrow are deeply pronounced. With the IV, extremely severe degree of chronic radiation sickness, the progression of pathological changes occurs steadily and quickly, leading to an inevitable fatal outcome.

Диагностика лучевой болезни

The development of radiation sickness can be assumed based on the picture of the primary reaction, the chronology of the development of clinical symptoms. It facilitates the diagnosis of the fact of radiation damage and dosimetric control data.



The severity and stage of the lesion can be determined by a change in the picture of peripheral blood. With radiation sickness, there is an increase in leukopenia, anemia, thrombocytopenia, reticulocytopenia, and increased ESR. When analyzing biochemical parameters in the blood, hypoproteinemia, hypoalbuminemia, and electrolyte disorders are detected. The myelogram shows signs of pronounced hematopoiesis depression. With a favorable course of radiation sickness, the reverse development of hematological changes begins in the recovery phase.

Other laboratory diagnostic data are of auxiliary importance (microscopy of skin and mucous ulcer scrapings, blood culture for sterility), instrumental studies (EEG, electrocardiography, ultrasound of the abdominal cavity, pelvis, thyroid gland, etc.), consultations of narrow-profile specialists (hematologist, neurologist, gastroenterologist, endocrinologist, etc.).

In acute radiation sickness, the patient is hospitalized in a sterile box, providing aseptic conditions and bed rest. Priority measures include PHO ras, decontamination (gastric lavage, enema, skin treatment), administration of antiemetics, elimination of collapse. During internal irradiation, the administration of drugs that neutralize known radioactive substances is indicated. In the first day after the appearance of signs of radiation sickness, powerful detoxification therapy (infusions of saline, plasma-substituting and saline solutions), forced diuresis is performed. In cases of necrotic enteropathy, hunger, parenteral nutrition, and treatment of the oral mucosa with antiseptics are prescribed.

In order to combat hemorrhagic syndrome, blood transfusions of platelet and erythrocyte mass are performed. With the development of DIC syndrome, transfusion of freshly frozen plasma, plasmapheresis is performed. In order to prevent infectious complications, antibiotic therapy is prescribed. A severe form of radiation sickness, accompanied by bone marrow aplasia, is an indication for its transplantation. In chronic radiation sickness, therapy is mainly symptomatic.

Prognosis and prevention

The prognosis of radiation sickness is directly related to the massiveness of the radiation dose received and the time of the damaging effect. Patients who have survived the critical period of 12 weeks after irradiation have a chance of a favorable prognosis. However, even with illegal radiation damage, the victims may subsequently develop hemoblastoses, malignant neoplasms of various localization, and various genetic abnormalities may be detected in the offspring.

In order to prevent radiation sickness, persons in the area of radio emission should use personal radiation protection and control equipment, radioprotective drugs that reduce the radiosensitivity of the body. Persons in contact with ionizing



radiation sources must undergo periodic medical examinations with mandatory hemogram monitoring.

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