FACTORS OF RADIATION RISK AT RADIODIAGNOSIS AND RADIATION THERAPY IN HEALTHCARE INSTITUTION

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Negative and positive impact of radiation exposure on health of the person is surveyed. The factors of radiation risk to which patients and personnel at radiation diagnosis and radiation therapy are exposed to, have been analyzed on the example of work of physics and technology radiological department of the Vitebsk Regional Clinical Oncology Dispensary. The sources of ionizing radiation used in diagnostic and medical practice have been described.

Keywords: radiation, source of ionizing radiation, radiation diagnosis, beam therapy, radiation protection.

The Republic of Belarus is the most affected republic as a result of the Chernobyl accident. The territory of the country was contaminated with about 70 % of all dose-forming radionuclides: isotopes of iodine-131, caesium-137, strontium-90 as well as transuranium elements. After the accident, a dramatic increase in the incidence of thyroid cancer was detected. Moreover, the number of other oncological diseases is growing every year in the Republic of Belarus.

However, ionizing radiation not only does harm to health, but also can treat a person. Medical exposure is the basis for the detection and treatment of cancer. It is used for radiation diagnosis and radiation therapy of malignant tumors. The nature of the effect of ionizing radiation on a person is determined by the type of radiation, the intensity of radiation and the individual characteristics of the organism.

The factors of radiation risk to which patients and personnel at radiation diagnosis and radiation therapy are exposed to, have been analyzed on the example of work of physics and technology radiological department of the Vitebsk Regional Clinical Oncology Dispensary. The department has a wide range of diagnostic and therapeutic options. For X-ray diagnostics, a modern 64-slice X-ray computer tomograph from TOSHIBA Aquilion One is used, open radionuclide sources are radopharmaceuticals labeled with Tc-99m, Ga-67, I-131. For pre-radial preparation, remote and contact radiotherapy, the department has modern equipment: X-ray computer tomography HiSpeed CT \ e GE Medical Systems; X-ray simulator Acuity IX; Linear electron accelerators CLINA-IX, equipped with the latest options, such as IMRT, RapidArc, IGRT; gamma therapeutic unit "TERAGAM"; brachytherapy apparatus VariSourse 200e; brachytherapy apparatus GammaMedplus IX; intracavitary gamma-therapeutic apparatus AGAT-VU. The following sources of ionizing radiation (IRI) are used in laboratory research and treatment:

Cobalt-60 type GK60T05, type of radiation is gamma, aggregate state is solid, metal, launch date is 10.09.2009, service life is15 years. Cobalt-60 type GK60T05 in terms of radiation hazard refers to category I.

Cobalt-60 type GK60T2, type of radiation is gamma, aggregate state is solid, metal, in the number of three pieces: activity 67,10 GBq, 67,12 GBq, 67,62 GBq, service life is not more than 5 years. This type of IRS in terms of radiation hazard refers to category II.

Iridium-192 type No. VS2000, activity is 0,465 TBq, type of radiation is gamma, aggregate state is solid, metal, service life is three months. The degree of radiation hazard refers to category II.

Iridium-192 type GM 12000680, activity is 0,555 TBq, type of radiation is gamma, aggregate state is solid, metal, service life is three months. This type of IRS in terms of radiation hazard refers to category II.

Hippuran-iodine -131, solution for injections in the vial, activity on the passport is 74 MBq, annual consumption is 2,072 GBq. Iodine-131 is a source of beta particles and gamma quanta, half-life is 8,1 days, shelf life is 21 days, delivery of the drug according to the order-application. Iodine-131 in terms of radiation hazard refers to category II.

Gallium citrate, Ga 67 is a chemical compound of sodium citrate with radionuclide Ga 67, solution for injections in vial, activity under passport is up to 420 MBq, annual consumption is up to 11,76 GBq. Ga 67 is a source of gamma quanta, half-life is 78,26 hours, shelf life is 11 days. The degree of radiation hazard refers to category II.

The radionuclide generator 99Mo / 99mTs. Tc99m-pertechnetate sodium (drug Polge-tech) is obtained by washing with 0,9 % NaCl solution of the column of the generator with the parent isotope of molybdenum-99. Activity on the passport is 5 GBq, annual consumption is 260 GBq. Tc99m decomposes, emitting gamma radiation, a half-life is 6,02 hours, and a shelf life is 14 days. The degree of radiation hazard refers to category II.

Radiation monitoring when working with ionizing radiation sources is carried out by the Radiation Safety Service, which has three dosimeters of the DKS-1121 type, two dosimeter-radiometers of the MKS-1117 type, dosimeters of the TLD type and 25 dosimeters DKG-FE2503A are available for individual dosimetric monitoring.

In the offices of megavoltage therapy, remote gamma therapy, intracavitary gamma therapy and contact radiation therapy, stationary dosimeters such as DKS-AT1119 and CPK-AE2327 are installed for constant monitoring.

IMPACT OF LASER IRRADIATION OF LOW INTENSITY ON HEMOGLOBIN

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Laser or optical quantum oscillator is a device that converts pump energy (light, electric, thermal, chemical, etc.) to the energy of a coherent, monochromatic, polarized and narrowly directed radiation flux.

The physical basis of the laser is the quantum mechanical phenomenon of stimulated (induced) radiation. The laser irradiation can be continuous, with a constant power, or pulsed, reaching extremely high peak powers.

Keywords: laser, hemoglobin, oxygenation.

According to its properties, laser irradiation refers to coherent monochromatic polarized electromagnetic radiation. The spectral characteristic of laser irradiation, or the length of its wave, is the most important indicator, which determines the biological effect on tissues and the body.

The main absorbing component in the irradiation of biological tissues by the laser is blood, which concentration of energy absorption is several times higher in the muscle tissue and tens of times in the physiological solution, and the acceptor factor of the laser irradiation is mainly in the hemoglobin of erythrocytes, which performs the most important function of the transport of oxygen to the tissues of the body.

The mechanism of action of low-level laser irradiation (LLLI) for homeostasis has been studied in terms of its activation by the oxygen-binding function of hemoglobin and the further transportation of oxygen to tissues, which will increase the compensatory functions of the organism both in the aspect of healing post-operative wounds, and ,possibly, in increasing the overall status of homeostasis .

Hemoglobin as the main source of the oxygen transport function of blood undergoes a number of changes under the influence of a helium-neon and semiconductor laser.

Oxygenation of hemoglobin is connected with the changes in the membrane of erythrocytes under the effect of the laser irradiation, which increases its permeability for the ions and the gases.

An increased degree of oxygenation of erythrocytes is associated with a complex mechanism of regulation of the fermentative and antioxidant complexes.

Low-energy laser irradiation has become widespread in various fields of biological sciences due to the fact that primary photobiological reactions cause various biochemical and physiological responses in the body.

As we know, one of the methods of laser therapy is laser hemotherapy, which includes Intravenous Laser Blood Irradiation (ILBI) and transcutaneous laser blood irradiation (TLBI).

The use of ILBI makes it possible to reduce the periods of treatment, to increase the time of remission, to stabilize the course of diseases, to reduce a quantity of postoperative complications, etc

However, the universality of the biological effect of LLLI, and of the ILBI method in particular, is due to the influence on the lower (subcellular and cellular) level of regulation and maintenance of homeostasis; the influence of LLLI also corrects the strategy of adaptation (physiological reactions) of a higher level of living organization as the disturbances of these mechanisms are the true cause of many diseases.

Laser technology is applicable for objects from a wide variety of materials located in various aggregate states, among which the most interesting and complex are the biological ones.

At the present time, there is an intensive introduction of laser irradiation in biological research and in practical medicine in most countries of the world. The unique properties of laser irradiation have revealed wide possibilities of its application in different fields of medicine: surgery, therapy and to diagnostics.