Department of Oncology and Radiology with Radiation Medicine

History of radiation medicine development. Natural radiation background. Artificial sources of ionizing radiation. Biological action of ionizing radiation

assistant Nestulia K.I.

Radiation medicine is a science that studies the features of the effects of ionizing radiation on the human body, the principles of treatment of radiation damage and prevention of possible effects of radiation on the population.

The Chernobyl tragedy has attracted the attention of many scientists to solve specific problems for the Chernobyl accident (long-term living in areas contaminated with radionuclides with different radiosensitivity, simultaneous
influence of a complex of adverse factors). Search results scientists in this area have enriched radiation medicine.

HISTORY OF RADIATION MEDICINE AND CONTRIBUTION OF UKRAINIAN SCIENTISTS IN ITS DEVELOPMENT

- he term "Radiation Medicine" was first used in 1955 in the USSR: that year a manual was published for doctors and students by a team of authors edited by the famous radiobiologist Academician A. Lebedinsky, entitled "Radiation Medicine" (M., "Medgiz", 1955). The book revealed the issues of pathophysiology, clinic and therapy of radiation sickness.
- After the radiation accidents in the Urals (at the Mayak nuclear power plant, 1949) and, especially, the Chernobyl accident (at Unit 4 of the Chernobyl NPP, 1986), which had consequences for hundreds of thousands of people and involved large contingents of doctors. and scientists, the term radiation medicine in the CIS has gained the status of a commonly used concept.

In Russia, Belarus, Ukraine and other CIS countries, scientific institutes and centers of radiation medicine have been established: 1) "All-Russian Center for Emergency and Radiation Medicine named after A.M. Nikiforova "2) Federal State Scientific Institution" Ural Scientific and Practical Center for Radiation Medicine ",

3) Scientific Center "Medical Radiology and Radiation Medicine" RAMS (Obninsk)

4) Research Clinical Institute of Radiation Medicine and Endocrinology of the Ministry of Health of the Republic of Belarus,

5) State institution "Science Center radiation medicine » NAMS of Ukraine

Wilhelm Conrad Roentgen— (March 27, 18


- February 10, 1923) - German physicist.

In 1895 he discovered the shortwave electro
radiation - x-rays. This is a discovery
had a huge impact on the further developm
in particular led to the detection of radioact

The first Nobel Prize in Physics in 1901 was awarded to X-ray. He contributed to the rapid practical application of his invention in medicine. The design of the X-ray tube created by him underlies modern devices.

Henri Becquerel, a Nobel laureate, was the author of the discovery of uranium salts invisible rays, similar to the X-rays recently described by Wilhelm K. Roentgen, who received a radiation burn of his skin with an ulcer from a radium ampoule he had worn in his waistcoat pocket for some time.

Maria Sklodowska-Curie is a two-time Nobel laureate, for the discovery and isolation of several radioactive elements, the main among
of which - polonium and radium, died of leukemia in a small hospital in the town of Sansellemoz in the French Alps.

Irene Joliot-Curie, daughter of Marie Curie and also a Nobel Prize winner for the discovery of artificial radioactivity.

Radiologist S.P. Grigoriev, founder of the X-ray Academy in Kharkiv (now - SP Grigoriev Institute of Medical Radiology of NAMI of Ukraine)

NATURAL RADIATION BACKGROUND

- It consists of three components:
- **Natural** - is radiation from natural radionuclides scattered in the earth's crust, soil, air, water and other objects of the environment;
- **Space** - is the second component of the radiation background of the earth;
- **Man-made** - terrestrial sources of radiation.

Paradoxically, the main part of the radiation dose from radon a person receives while in a closed unventilated room. The concentration of radon in such rooms is 8 times higher than in the surrounding air.

The source of radon entering the room is its impregnation through the foundation from the ground, sometimes freeing from the materials from which the houses are built. sealing the premises in order to insulate it led to high concentrations of radon in the premises. And in some houses, especially one-story, in which alumina was used for construction, the concentration of radon in the premises was 5ooo times higher than in the air

The second source of radon in the room, and hence in the body is water. Ordinary water contains much less radon than water from deep wells and artesian wells. However, the main danger is not drinking water, because people use mostly boiled water, which I advise you, the main danger is the ingress of water vapor with high radon content in the lungs, along with the inhaled air that often passes in the bathroom.

The third source of radon in the room is natural gas. Given that we mainly use gas stoves, this leads to a 3-fold increase in radon, it is necessary to install hoods above the stoves, which significantly reduces the concentration of radon.

Cosmic rays are uncharged elementary particles of ultrahigh energy (up to 10 ^^ eV) from interstellar space. They include protons, alpha particles and nuclei of light elements.

In contact with the molecules of the Earth's atmosphere, the primary cosmic rays create a discharge of secondary and tertiary radiation, the amount of which increases in the atmosphere to a height of 20-16 km, after which their flow weakens due to absorption by the atmosphere. At sea level, cosmic rays create an average radiation dose of 300 μSv / year (0.3 mSv / year), and in the mountains - several times higher (at the level of high peaks - up to 4500 μSv / year). For one flight between Paris and New York, each passenger of the aircraft receives a dose of 50 μSv (flight 7.5 hours at an altitude of 10-11 km). The total radiation dose of mankind, due to air travel, is a collective dose of about 2000 people-Sv per year.

The radiation of the earth's crust consists of gamma rays of radioactive elements - uranium-235, uranium-238, thorium-232 and their decay products, in particular radium-226, radium-224, rubidium-87.

These are the sources of human external radiation. The dose of external human radiation from terrestrial radiation is

300 - 600 μSv / year

(average 0.5 mSv / year),

but C% of the world's popul

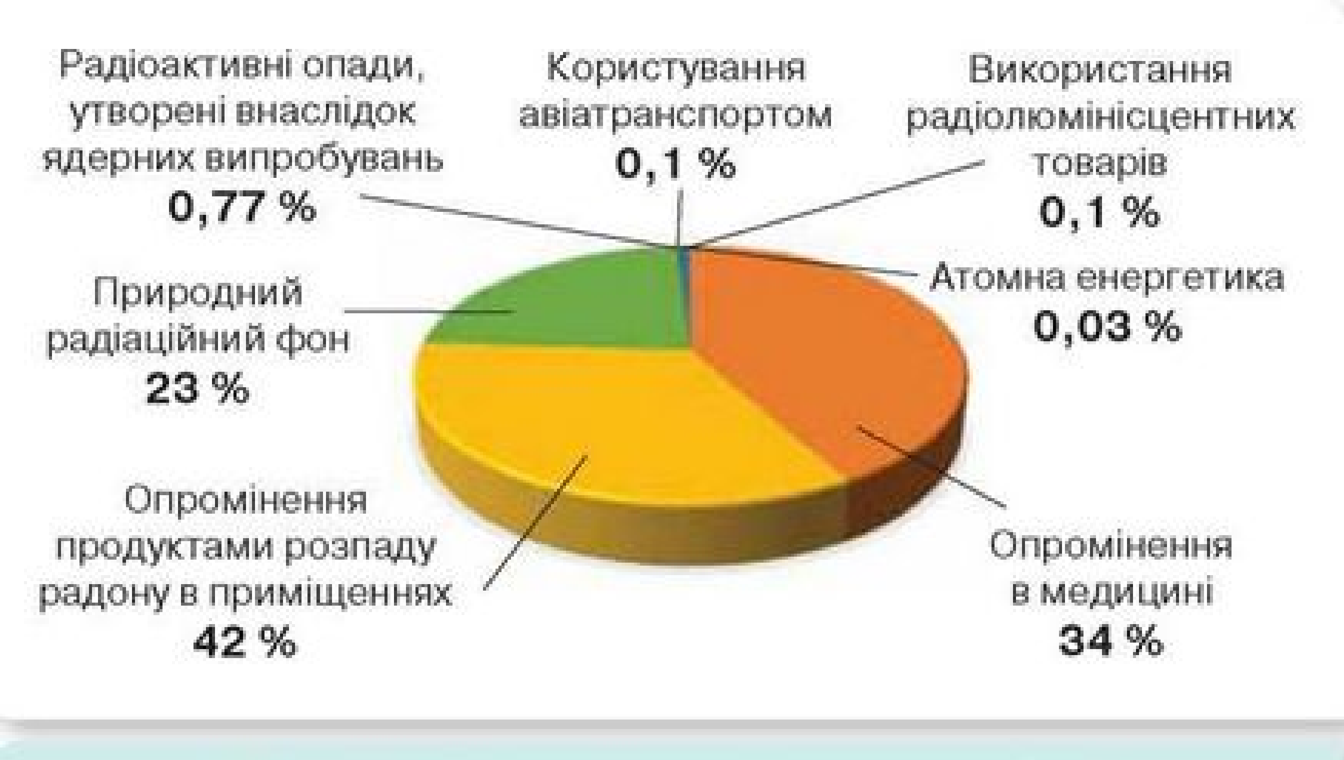
lives in the regions

with the level of irradiation

1000 μSv / year,

and 1.5% - up to 1400 μSv / y

even higher



Мал. 218. Діаграма розподілу джерел радіації

According to the UN Scientific Committee on the Effects of Atomic Radiation (NKDAR) (2001), the components of the natural radiation background, dose variations and
the average radiation doses of the Earth's population from them are as follows (in mSv / year):

- cosmic rays (0.3-1.0) 0.4;
- gamma radiation of the earth's crust (0.3-0.6) 0.5;
- inhalation (mainly radon) (0.2-10.0) 1.2;
- internal irradiation (mainly K-40) (0.2-0.8) 0.3;
- together (1.0-10.0) 2.4.

ARTIFICIAL (anthropogenic) SOURCES OF IONIZING RADIATION

- Artificial (anthropogenic) sources of ionizing radiation include:
- - nuclear weapons testing;
- - enterprises for extraction, processing and production of fissile materials and artificial radioactive isotopes;
- - institutions, enterprises and laboratories that use radioactive substances and technologies of production processes.

1. Testing of nuclear and thermonuclear weapons.

Atomic explosions produce the products of fission of nuclear fuel, which are often called fission fragments, and the environment receives a number of fissile materials.

When a thermonuclear device explodes, radioactive carbon 14 additionally arises.

Fission fragments are a complex mixture of radioactive substances formed during the fission of atomic nuclei. The nuclei of uranium atoms 235 or plutonium 239 are split into 80 different fragments. The latter begin to slowly disintegrate. The result is a complex mixture of fission products from 200 different isotopes of 36 chemical elements, the half-lives of which range from 1 second to tens of billions of years. By the nature of the radiation, almost all radioactive isotope divisions belong to beta or beta and gamma radiation.

The most potentially dangerous fragments due to their active inclusion in the biological cycle and a long half-life are considered to be 5 grams of strontium and cesium.

According to the WHO, the expected total collective effective equivalent dose of all nuclear explosions is 30 million people per 1 sievert.

2. Enterprises for extraction, processing and production of fissile materials and artificial radioactive substances

These are potential sources of environmental pollution.

These include nuclear industry enterprises:

- uranium mines and hydrometallurgical plants for the production of enriched uranium (uranium concentrate);
- plants for purification of uranium concentrates;
- experimental and power reactors;
- plants for the production of nuclear fuel.

At each stage of production there is a release of radioactive substances into the environment, and their volume can vary greatly depending on the design of the reactor and other conditions. In addition, a serious problem is the disposal of radioactive waste, which will continue to be a source of contamination for thousands and millions of years. Irradiation doses vary depending on time and distance. The farther a person lives from the station, the lower the dose he will receive.

In the State Department of Ecology and Natural Resources there are anti-radon measures, which include:

- special floor covering which does not pass radon;
- use of ventilation;
- eviction from people's homes;
- destruction of infected buildings.

3. Institutions, enterprises and laboratories that use radioactive substances in the technology of the production process.

This group of potential sources of radioactive contamination includes: - "hot" laboratories;

- radioisotope laboratories and radiological departments of medical institutions;

- laboratories of research institutes, where work is carried out in the field of biology and agriculture;

- radioisotope laboratories in industry and so on.

Medical X-ray machines. Used for fluoroscopy, radiography and radiation therapy (xytherapy). Protection in medical X-ray rooms is provided for both staff and patients. Modern X-ray equipment structurally provides low levels of radiation to staff, so the allowable dose is never exceeded.
To protect personnel use a variety of additional protective devices and things: small and large screens made of protective materials, personal aprons, gloves made of leaded rubber.

The radiation dose of patients during radiation therapy is determined by the doctor depending on the type of disease within the limits that provide optimal therapeutic effect. Rules for reducing "non-working" exposure of patients, the most important of which is: only the area of the body that is diagnosed or treated should be irradiated.

DOSIMETRY OF IONIZING RADIATION

- **Dosimetry** is a branch of physics on the problems of determining the amount and distribution of absorbed energy of IP in the environment. Fundamental in dosimetry is the concept of dose.
- **A dose** is the energy transmitted per unit mass of a substance by a stream of radiation.

Direct dose measurement is performed in certain media, which are called dosimetric model media. Gases, solids and liquids are used as such. Accordingly, the detectors of devices designed to measure the dose - dosimeters - are divided into gaseous, solid and liquid. By type of effects, radiation detectors and, accordingly, dosimetry methods are divided into:

- ionization,
- scintillation,
- thermoluminescent (TL),
- film (photographic),
- thermal,
- chemical.

Measures of radiation exposure:

- exposure dose,
- absorbed dose,
- dose equivalent,
- effective dose,
- collective effective dose.

To determine the value of these doses use the units:

- for exposure dose - pendant per kilogram (K / kg) - coulomb per kilogram (C / kg) and X-ray (P) - X-ray (R),
- for the absorbed dose - rad (rad) and gray (Gy) - gray (Gy),
- for the equivalent dose - ber (rem) and sievert (Sv) - sievert (Sv),
- for an effective dose - sievert (Sv) - sievert (Sv),
- for a collective dose - human-sievert (people-Sv).

The name of the unit "rad" is an acronym for "radiation absorbed dose". Its value is equal to 100 ergs of energy absorbed in 1 gram of substance

Measures against ionizing radiati

- Organizational measures against ionizing radiation include ensuring compliance with radiation safety standards. Premises that are designed to work with radioactive isotopes must be isolated from others and have specially treated walls, ceilings, floors. Open sources of radiation and all objects that are irradiated must be in a limited area, where staff are allowed in exceptional cases, and even then for a short time. Containers, equipment, doors and other objects are marked with a radiation warning sign (on a yellow background - a black schematic shamrock).