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FORENSIC MEDICAL DIAGNOSIS OF ACUTE RADIATION TRAUM

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ANNOTATION

Current issues of forensic medical diagnostics of acute radiation injuries were considered. Based on the generalization of the personal experience of the authors and literature data, general and specific issues of organizing and conducting forensic medical work in various variants of radiation injuries were thoroughly covered. Special attention was paid to the specifics of retrieving and referring autopsy materials for additional laboratory studies, as well as measures for radiation protection of medical personnel.

Keywords: forensic medical examination of the corpse, acute radiation sickness, autopsy technique.

The events of the 20th and early 21st centuries (particularly, the accident at Japan's Fukushima-1 nuclear power plant) demonstrate that the possibility of large-scale radiogenic emergencies has become a reality. Under such conditions, it is quite possible for people to be massively infected, leading to the development of acute radiation sickness, which often leads to death. In this regard, it is clear that specialist physicians in the field of forensic medicine must have an objective understanding of the specifics of organizing and conducting examinations for this type of injury. However, due to the relative rarity of cases of acute radiation damage in expert practice, these issues have not been sufficiently covered in domestic and foreign specialized literature. The above led the authors to summarize their own many years of experience in conducting such examinations, presenting them in the form of practical recommendations presented in this publication.

First of all, it should be borne in mind that the procedure for forensic medical examination of the bodies of persons who died from acute radiation sickness has a number of features determined by the radiation situation, information about which must be provided to the expert responsible for the examination before the start of the examination. In this case, it is necessary to take into account the possible contamination of the body's skin with radionuclides and/or the presence of radioactive substances in the body of the deceased. In this regard, before the start of forensic medical examination of the corpse, if there is a suspicion of exposure to radioactive substances, a physician-dosimetrist summoned by the investigative authorities conducts a thorough dosimetric examination of the clothing on the corpse (if any) and the corpse itself. Clothing is removed and, depending on the level of radioactive contamination, is either subjected to preliminary mechanical decontamination or examined by an expert without such conduct. In cases where radioactive contamination of the body's skin is detected during dosimetric control, it is thoroughly examined to determine whether there are other contaminations on the victim's body that may be relevant to the investigation of the accident. In the absence of such substances, the skin of the corpses is also subject to mechanical decontamination, for which it is washed three times with soap or conventional detergent, followed by additional treatment with special agents (preparations "Zashita," "Radez," etc.). Due to the fact that such processing can lead to the loss and/or significant change in the appearance of external injuries, both in terms of severity and size, before the start of decontamination measures, it is necessary to carry out a detailed description of the external changes on the body of the deceased in parallel with their photo and video recording. The duration of work with the body in cases of contamination with radioactive substances must be such that it does not allow the absorbed dose to exceed the permitted regulatory levels according to the parameters of the "Radiation Safety Standards" of the Russian Federation, approved by the IAEA.

Contamination of the corpse with radioactive substances is considered dangerous for the work of medical personnel if the exposure dose at a distance of 1-1.5 cm from the body surface

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exceeds 100-200 mR/h. If the above-mentioned decontamination measures do not ensure compliance with the permissible levels of radiation exposure for medical personnel, a control time for working with the corpse is established, and radiation protection measures are specified. The specified data are entered in the certificate, which is compiled by the dosimetric service and transferred to the expert responsible for organizing the forensic examination of the corpse.

Based on the specific radiation situation and the level of radiation from the victim's body, the necessary number of expert teams is formed. Each team must include at least 2 forensic medical experts, a laboratory assistant, and a orderly. The circle of persons allowed to participate in the work with the corpse is determined by the investigative bodies and the expert responsible for the examination. With the permission of investigative bodies, in cases of death of victims of radiation exposure, the presence of a pathologist and clinicians of specialized medical institutions is advisable during the examination of corpses.

In the case of death from external gamma radiation, the examination of the corpse is carried out in the usual manner according to the generally accepted methodology, examining the organs of three main cavities - the chest, abdomen, and skull cavity. In cases where it is known or presumed that the incorporation of radionuclides with selective deposition in certain organs and tissues of the body (in particular, iodine-131, which selectively accumulates in the thyroid gland) has taken place, it is necessary at the initial stage of forensic medical examination of the corpse to extract the corresponding organs with subsequent separate radiometric and pathomorphological examination.

Forensic examination of the corpse is carried out in separate, specially designated sectional rooms equipped with special sewage system devices. In the absence of such premises, in order to prevent the possible spread of radioactive contamination, it is necessary to have sealed containers for collecting biological fluids and waste at the time of opening, with their subsequent dispatch to centralized burial points. Upon completion of the autopsy procedure, the sectional rooms are disinfected by washing the walls, ceiling, and floor using special and household detergents, including washing powders, followed by jet washing. The same decontamination measures are carried out in auxiliary premises and in body storage facilities.

During the entire period of the corpses' stay in the morgue, during the autopsy, and until the completion of the decontamination procedures, all affected premises are enclosed with standard warning signs "radiation hazard." Visiting these premises is strictly controlled. The bodies of the deceased are not handed over to relatives and are buried in closed coffins.

All participants in forensic medical examinations of the bodies of persons who died as a result of radiation incidents and accidents must be provided with individual dosimeters. Upon completion of the autopsy, all participating medical personnel leave the used work clothes in the section block, undergo sanitary treatment, and upon leaving the section block, are subject to mandatory dosimetric control.

During forensic medical examination of corpses, if radiation injury is suspected, material must be taken for additional laboratory tests (forensic histological, radiometric, bacteriological).

From the corpses of persons who died during or after a radiation incident, the following objects must be taken for forensic histological examination: blood-forming organs (bone marrow and lymph nodes of at least 5 anatomical locations, spleen, thymus); digestive organs (tongue, salivary glands, pharynx, esophagus, stomach, duodenum, jejunum, ileum, cecum, transverse colon, sigmoid colon, rectum, liver); lungs, trachea; cardiovascular system (right and left atrium, right and left ventricles, interventricular septum, papillary muscle, aorta); urogenital system (kidneys, bladder, prostate gland, uterus); nervous system (head and spinal cord);

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endocrine system (pituitary gland, thyroid gland, adrenal glands, pancreas, testes, epididymis, ovaries); skin (head, neck, chest, abdomen; in cases of fresh and old radiation injuries, chronic radiation ulcers, traces of previous The need for detailed microscopic examination is due to the possible variety of radiation conditions (including sharply uneven) of various parts of the body, for example, during accidental shielding, which allows for the over-radiation of some regional sections in combination with low radiation of others. In the order for forensic histological examination, in addition to generally accepted data, information is indicated on the possible radioactive contamination of biological samples, the duration of radiation exposure, the detected macroscopic changes, and all seized objects are listed according to the numbers.

For radiometric (biophysical) research during the incorporation of radioactive substances, the material is taken and marked according to the same scheme as for forensic histological examinations. In this case, pieces of skeletal muscles, liver, lungs, and subcutaneous fat are additionally removed. Mass of each sample

tissue or organ should be at least 20 g (optimally 30 - 50 g).

In addition to the biological samples mentioned above, to retrospectively assess the absorbed dose based on the magnitude of electron paramagnetic resonance (EPR), teeth (1-2 molars without pathological changes), as well as nails, bone fragments, and the victim's clothing items (primarily made of white/undyed cotton fabric with minimal contamination) are sent for biophysical examination. Due to the fact that only local absorbed doses of γ-radiation are evaluated by the EPR spectrometry method, the selection of biopreparations for EPR analysis (in particular, bone fragments) should be carried out in the maximum possible number of anatomical localizations, allowing for the restoration of uneven external γ-radiation doses according to the assumed radiation geometry.

In cases where biophysical examination can be conducted shortly after autopsy, each taken biological tissue sample with a label is placed in a separate dry container and immediately transferred to a specialized laboratory. If it is located in another settlement, then the biological material is placed in a refrigeration chamber or formalin and is kept in this state until the beginning of the study. The material is delivered personally to the institution staffed by the state biophysical laboratory (in Moscow - the A.I. Burnazyan Federal Medical Biophysical Center).

If there is suspicion of the presence of a neutron component among the radiation factors affecting the body of the deceased, to assess the dose of neutron radiation based on the products of neutron activation, it is necessary to additionally take blood samples (volume of at least 100 ml) and hair samples from the head and other areas of natural hair growth (face, pubis, armpit, chest, upper and lower extremities). Due to the short half-lives (several hours) of neutron activation products (in particular, 24Na, 32P, etc.), the selected biological samples must be transferred to a specialized biophysical laboratory as soon as possible after the radiation incident. In the direction for biophysical research, in addition to the previously listed data, information about the deceased's profession, possible radiation exposure and radioactive contamination conditions, duration of stay in the affected area, radiation level in the work area, composition of nuclides in this zone, individual and group dosimeter indicators are indicated. In addition, it is necessary to indicate the location of the injured person relative to the "epicenter" of the accident and whether they had special or accidental protection during work, as well as the medical institution where the patient was observed, blood test indicators in dynamics, the surname of the treating physician and the expert who performed the autopsy. For bacteriological examination, biological objects (blood and internal organ fragments) should be taken within the first 24 hours from the moment of death, using sterile instruments,

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slides, and dishes. The cadaver's blood (5-10 ml) is taken from the heart before the brain is removed. Pieces of the lungs, liver, and brain measuring 1×1×2 cm are taken with a scalpel heated on a spirit lamp after preliminary burning of the corresponding areas of the organ surface with a heated spatula. Samples of lung tissue are taken from the root areas and (if necessary) from the middle of each lobe. The retrieved autopsy material is placed in sterile jars or test tubes, sealed with coated stoppers, labeled and sealed as for forensic chemical analysis, carefully packaged, and sent to the bacteriological laboratory.

Forensic medical examination conclusions are formulated after the completion of all additional laboratory studies, taking into account the known circumstances of the case, investigation materials, medical documents, and conclusions of specialists in the field of radiation medicine and other specialties, depending on the specific situation. At the same time, such examinations should be commission-based, taking into account their particular complexity and specifics.

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