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The Place of Radiation Diagnostics Today

Jonibekov Jasurbek Jonibekovich
Bukhara State Medical Institute, Republic of Uzbekistan, Bukhara city

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ABSTRACT

More than 100 years have passed since the discovery of X-rays by Conrad William RoeMore than 100 years have passed since the discovery of X-rays by Conrad William Roentgen. The further rapid development of radiation diagnostics led to the invention and rapid introduction into clinical practice of the currently widely used methods of ultrasound diagnostics, computer and magnetic resonance imaging, positron emission tomography, as well as radionuclide diagnostic methods. Radiation examinations are an integral part of modern clinical examination of the patient and the main sources of obtaining objective information necessary for timely diagnosis, accurate localization and extent of the detected pathological changes, and assessment of their dynamics during treatment. The state strategy for the development of radiation diagnostics has identified a number of areas that are successfully implemented in the N.I. Pirogov NMHC. First of all, it is the introduction and development of modern digital technologies. Currently, the classic X-ray machines for three workstations (imaging, X-ray and linear tomography) have been replaced with a remote-controlled one workplace equipped with a digital X-ray machine. The angiography department is equipped with subtraction digital units. The number of special digital devices (mammographs, dental X-ray machines) has increased. Replacing analog X-ray machines with digital ones significantly reduced the examination time and improved the quality of X-ray images. The darkroom process has been eliminated everywhere, compact digital image archives have been created. The development of digital technologies has made it possible to create a system for organizing, distributing and storing (archiving) digital images (Picture Archiving and Communication Systems – PACS).

Materials and methods. The hospital network of teleradiology allows for a quick exchange of information between departments and offices. Almost immediately after the study, the Center's doctor can view digital images of his patient. Ultrasound technologies have been enriched with new programs for digital processing of the echo signal, Dopplerography is intensively developing to assess blood flow. The use of high-speed, special highly sensitive color Doppler systems and digital ultrasound image processing programs contributed to the emergence of the energy Doppler and Doppler angiography method, which significantly expands the diagnostic framework for assessing the nature of central and peripheral blood flow, detecting circulatory disorders and, in particular, early signs of malignant neoplasms. The development of X-ray computed tomography has led to the widespread use of multispiral computed tomography in the CT rooms of the Center, which allows scanning at a speed along the longitudinal axis up to 40 cm / s, which made it possible to obtain an image of coronary vessels in one cardiac cycle, to perform a study of the vessels of the whole body in a matter of seconds. Two-energy computed tomography made it possible to move to the spectral level of the study. Thanks to the study at two different energy levels, it became possible to assess the distribution of various substances, such as iodine, xenon in the parenchyma of organs. Endovascular and vascular surgeons can now plan surgical interventions based on the data provided by CT and MR angiography, in most cases

there is no need to perform invasive diagnostic procedures before intervention. A certain breakthrough occurred in MRI studies. An increase in the magnetic field strength to 3 T made it possible to improve the resulting images several times, increase the signal-to-noise ratio. Now we have the opportunity to evaluate not only the structure of various organs, but also to evaluate blood flow, perfusion, including those performed without the introduction of a contrast agent. Modern neurosurgical operations, including "Awake surgery", are performed taking into account the functional data obtained before the operation (functional MRI), which allows the surgeon to remove the pathological focus without damaging various functionally active areas of the brain and pathways. The widespread introduction of digital technologies into the methods of radiation diagnostics has qualitatively and informationally changed the images of the studied organs. Volume reconstructions of images obtained by CT, MRI, ultrasound, radiography, angiography and radionuclide studies have become in demand among doctors of clinical departments – that is, with the entire spectrum of modern medical imaging methods. This helps to more clearly represent the localization and spread of the pathological process. The introduction of clinical recommendations, as well as protocols for the management of patients with various pathologies, made it possible to take a differentiated approach to the choice of the radiation method of examination at the Center. Currently, ultrasound has become the main method in the study of the abdomen, heart, pelvis, soft tissues of the extremities, the importance of the method in the study of endocrine, mammary glands, intracavitary studies has increased. Interventional technologies are widely used in the field of angiography. Multispiral computed tomography has become a method of both primary and clarifying diagnostics of pathology of almost any organ and system, especially in urgent situations. More and more clinical space is occupied by magnetic resonance imaging, as an integral part of the diagnosis of various neurological and neurosurgical conditions, for the evaluation of the gastrointestinal tract, pelvis, musculoskeletal pathology. Equipping the radionuclide diagnostics department with single-photon computed tomography (SPECT) combined with CT allowed combining the advantages of a multi-detector gamma camera and an X-ray computed tomograph. The images obtained, including in 3-dimensional volume, allow detecting small lesions at early clinical stages. All this has significantly expanded the possibilities of early diagnosis of heart, lung, and brain diseases, and increased the detection of oncological diseases. Much attention is paid to the widespread elimination of invasive methods and methods associated with a large radiation load. Modern iterative reconstruction protocols make it possible to obtain images with a 20-70% reduction in the dose received by the patient. Already today, myelography, pneumomediastinography, bronchography, intravenous cholangiography, retrograde pyelography, angiographic studies of parenchymal organs have disappeared from the arsenal of diagnostic techniques, and the tasks solved by these studies are assigned to ultrasound, CT, MRI, which has raised the informative value of research to a new qualitative level, and some of the new methods have completely eliminated radiation exposure. Interventional radiology has developed rapidly with the extensive involvement of radiation diagnosticians in this work. Currently, diagnostic tests in the angiography department are minimized and the main burden on the department. it is associated with the implementation of interventional methods of treatment. The Center has established a department of minimally invasive methods of diagnosis and treatment, in which, over the past years, diagnostic punctures of formations and parietal soft tissue growths in the cavity of cysts have been successfully carried out in order to collect material for laboratory examination, drainage of fluid accumulations and cavities, percutaneous transhepatic drainage and stenting of bile ducts. NMHC named after. N.I. Pirogova is a pioneer of the use of high-frequency ultrasound for ablation of uterine tumors (fibroids) and bone metastases (Hi Fu technology). Thus, in connection with the improvement of the technical base of radiation diagnostics, its introduction into all clinical specialties, the role of a specialist in this field is also changing. In order to preserve radiation diagnostics as a single discipline, radiologists, ultrasound diagnostics doctors

should play the role of experts on the rational use of methods and the choice of the optimal strategy for examining the patient. Modern diagnostic methods (first of all, this applies to CT, MRI and ultrasound) allow you to obtain excellent diagnostic images that are almost identical to the real anatomy of the organ. However, the main goal of modern radiation diagnostics is not just to create "beautiful images", but to use the full potential of a new generation of medical equipment for fast and accurate diagnosis in order to reduce morbidity and mortality of the population.

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