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THE HISTORY OF THE DEVELOPMENT OF RADIATION DIAGNOSTICS

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Annotation

An ancient Latin proverb says: "Diagnosis cetra - ullae therapiae fundamen-tum" ("A reliable diagnosis is the basis of any treatment"). For many centuries, the efforts of doctors have been aimed at solving the most difficult task - to improve the recognition of human diseases. The need for a method that would allow to look inside the human body without damaging it was enormous, although not always realized. What a great benefit a direct examination of the human body would bring if it suddenly became "transparent"! And hardly any of the scientists of the past could have imagined that this dream is quite feasible.

Keywords: X-RAY, ultrasound diagnostic, computed tomography, MRI, PET

The story begins in 1895, when Wilhelm Konrad Roentgen first registered the darkening of a photographic plate under the action of X-rays. He also discovered that when X-rays pass through the tissues of the hand, an image of the bone skeleton is formed on a photographic plate. This discovery became the world's first medical imaging technique. The first X-ray image was taken in the 19th century.

Less than a month after the publication of Roentgen on January 20, 1896, doctors of the city of Dartmund (USA), using "his" rays, saw a broken arm. Three months after the discovery of Roentgen, Italian physicist Enrico Salvioni created the first fluoroscopic apparatus, which consisted of an X-ray tube and a fluorescent screen on one side and an eyepiece on the other. The person was placed between the X-ray tube and the screen, on which the image could be seen even in an un-dark room. Later, instead of classical fluoroscopy, X-ray television transmission was used, in which X-rays fall on the URI (X-ray amplifier), which includes an image intensifier (image intensifier). The resulting image is displayed on the monitor screen.

In 1919, physician Carlos Huser (Argentina) carried out the first X-ray examination of the vascular system with intravenous administration of a contrast agent. Potassium iodide was used as a contrast agent, due to which the vessels became opaque to X-rays. In 1927 g.

The method of X-ray angiography, which is still used today, was first developed and implemented: the Portuguese doctor Egas Moniz obtained an image of the cerebral vessels. In the 50s. XX century X-ray surgery is actively developing. Some surgical procedures can be performed under X-ray guidance, reducing the invasiveness of the procedure.

In the 20s. of the last century, the standard radiation loads required to obtain high-quality images were determined. The use of special lead screens has become mandatory for research. The requirements are becoming more and more stringent: since its appearance (in 1931), the permissible radiation exposure during the study has decreased by more than 10 times. X-ray diagnostics has firmly entered the practice of doctors, becoming a universal method for diagnosing various pathologies of the human body.

In 1946, at a meeting dedicated to the 50th anniversary of radiology, the well-known Soviet clinician and healthcare organizer N.N. Priorov said: “What would become of phthisiology and urology, gynecology and otolaryngology, neurology and oncology, surgery and orthopedics, ophthalmology and traumatology, if only to deprive them of what radiology has given in the field of diagnosis and treatment? "

The further development of radiology led not only to the improvement of technology, but also to the rapid development of various directions in radiology, as well as methods for studying various organs and systems. The branches of diagnostics began to emerge for almost every branch of medicine: roentgenosteology, roentgenocardio- and angiology, roentgenopulmonology, roentgenogastroenterology, roentgenohepatology, neuroradiology, roentgenourology and roentgenonephrology, obstetric and gynecological roentgenology, roentgenomammology.

Conventional radiography remains the primary method of primary examination. This is due to the low radiation dose on the patient and the low cost of the study in comparison with other methods with a rather high information content. Devices for radiography are being improved, devices with digital image processing have reduced the dose of radiation by an order of magnitude, increasing the quality of the image, which has become possible to undergo computer processing, to store it in memory. The need for X-ray film and archives has disappeared. Now you can transfer images over cable networks, process them on a monitor.

It was impossible to foresee the astonishing speed of the introduction of scientific and technological progress into classical X-ray diagnostics, but it was the new horizons of X-ray research that opened with the creation of digital technologies, which made it possible dozens of times to reduce the dose of radiation and to increase the information content of the image by the same amount, improve its quality, expand the scope and reduce the cost of the procedure. The period of radiology XXI century has come a.

Spiral scanning technology has significantly reduced the time spent on CT examination and significantly reduced the radiation exposure of the patient.

The fundamental difference between MSCT and spiral tomographs of previous generations is that not one, but two or more rows of detectors are located along the circumference of the gantry.

In 1992, the first 2-slice (2-helix) MSCT tomographs with two rows of detectors appeared, and in 1998 - 4-slice (4-helical) tomographs with 4 rows of detectors, respectively.

They allow not only obtaining images, but also making it possible to observe physiological processes in the brain and heart in almost "real time". The results of these studies later formed the basis for the development of devices for emission computed tomography.

Magnetic resonance imaging method. The MRI method has gone beyond laboratory research quite recently - in the early 80s. and to date, the development of computer and measuring technology and the emergence of the latest technologies for creating homogeneous magnetic fields have put it on a par with CT methods, and in some cases brought it to the first place.

In 1952 Bloch and Purcell received the Nobel Prize for the independent discovery of nuclear magnetic resonance (NMR) in 1946. In 1950 - 1970. magnetic resonance techniques have been developed and used for the chemical analysis of molecules. In 1971, Raymond Damadian showed that the relaxation times of normal tissue and cancerous tumors differ, motivating scientists to seriously consider magnetic resonance as a diagnostic method.

The magnetic resonance device was demonstrated by Paul Lauterbur. He used the mathematical apparatus of inverse transformations used in CT. Lauterbur obtained the world's first 2D NMR image of two glass capillaries filled with liquid in 1973. However, this image took 4 hours and 45 minutes.

At the moment, more than 30 thousand MRI scans have been installed around the world, performing 60 million examinations per year. More than 70% of the MRI fleet is made up of models with superconducting magnets (0.5 - 3.0 T).

Positron emission tomography method. The principle of PET is based on the phenomenon of registration of 2 oppositely directed gamma rays of the same energy resulting from annihilation. The annihilation process occurs when a positron emitted by the nucleus of a radionuclide (radioisotope) meets an electron in the patient's tissues.

Radiopharmaceuticals (RFPs) used in PET are substances involved in various metabolic processes. In the production of RFP for nuclear medicine, some atoms are replaced by their isotopes.

A specific feature of RPs used in PET is that short-lived radioisotopes are used in their production, which must be produced in the immediate vicinity of the research site.

The first clinical PET scans appeared in the early 70s. of the last century and were imperfect: they were equipped with a small number of detectors, there was no possibility of simultaneous collection of information for several sections, the thickness of the sections was large.

However, the lack of the ability to detail anatomical structures, according to PET, could not delay the spread of the technique in clinics. The method made it possible to obtain truly functional images based on selected metabolic chains. Initially, it was assumed that the main application of PET would be cardiology, but now more than 90% of research is oncology. The possibilities of PET for diagnostics in neurology are expanding.

The rapid development of PET is due to the fact that every year a large number of new radiopharmaceuticals appear, the use of which opens up new horizons for the use of this method of radiation diagnostics. It is the choice of a suitable RPP that allows PET to study such different processes as metabolism, transport of substances, ligand-receptor interactions, gene expression, etc. The use of RPPs belonging to different classes of biologically active compounds makes PET a fairly universal tool in modern medicine. Therefore, the development of new radiopharmaceuticals and effective methods for the synthesis of already proven drugs is currently becoming a key stage in the development of the PET method.

To date, PET is mainly used positron-emitting isotopes of the elements of the second period of the periodic table: carbon-11 (T1 / 2 = 20.4 min), nitrogen-13 (T1 / 2 = 9.96 min), oxygen-15 (T1 / 2 = 2.03 min), fluorine-18 (T1 / 2 = 109.8 min). At the same time, PET makes it possible to quantify the distribution of radioactivity per milliliter or gram of body tissue.

Maximum intensity projection (MIP) image of a PET study.

The PET method is constantly being improved, new radiopharmaceuticals, clinical packages for research and the tomographs themselves appear. All major manufacturers of medical diagnostic equipment have developed and produce PET combined with CT scanners. These systems provide functional data (PET images) and anatomical data (X-ray CT images) in a single study.

Ultrasound examination (ultrasound). One of the most popular and informative methods of radiation diagnostics are ultrasound studies. The study of ultrasound is a branch of acoustics. The parameters characterizing ultrasound are, first of all, the frequency of oscillations per second (the unit of measurement is Hz). So, for the ultrasound range, this figure is over 16,000 Hz. The next 2 interrelated indicators characterizing ultrasound (like any other wave radiation) are wavelength and propagation velocity. There is an inverse relationship between these indicators. The amplitude of the ultrasonic wave oscillations (at the same frequency) characterizes the power of the ultrasonic energy.

The nature of the propagation of ultrasound through a particular medium depends on the ultrasound resistance (impedance). When passing through a homogeneous medium, the path of the ultrasound beam is a straight line. When reaching the boundary of media with different densities (ie, ultrasonic resistance), part of the ultrasound is reflected, while the other continues to propagate through this medium. The greater the difference in ultrasound resistance, the stronger the degree of ultrasound reflection. The second factor affecting the degree of ultrasonic reflection is the angle of incidence of the beam on interface between media: the greater the angle approaching the straight line, the stronger the degree of reflection.

The first attempt to make phonograms of the human body dates back to 1942. The German scientist Dussile "illuminated" the human body with an ultrasonic beam and then measured the intensity of the beam that passed through the body (Mühlhauser's X-ray technique). At the beginning of the 50s. XX century American scientists Wild and Haury were the first and quite successfully used ultrasound in a clinical setting. They focused their research on the brain, since X-ray diagnosis is not only difficult, but dangerous. Obtaining such information using X-rays takes about an hour, which is highly undesirable in a serious patient's condition.

According to the principle of operation, all ultrasonic devices are divided into 2 groups: echo pulse and Doppler. Group I devices are used to determine anatomical structures, to visualize and measure them. Devices of the II group make it possible to obtain a kinematic characteristic of rapidly proceeding processes - blood flow in vessels, heart contractions. However, this division is arbitrary. There are installations that make it possible to simultaneously study both anatomical and functional parameters. Three methods of ultrasound diagnostics are most widely used in clinical practice: 1-dimensional examination (echography), 2-dimensional examination (scanning, sonography) and Doppler ultrasonography.

The image obtained during the examination may differ depending on the operating modes of the scanner. The following modes are distinguished:

▪ A-mode (amplitude) - one-dimensional method gives information about the distances between tissue layers along the path of the ultrasound pulse;

▪ B-mode (bright) - provides information in the form of two-dimensional gray-scale tomographic images of anatomical structures in real time, which makes it possible to assess their morphological state;

▪ M-mode (motion) - one-dimensional image, the second coordinate is replaced by a time one. The vertical axis is the distance from the sensor to the structure to be located, and the horizontal is the time. The mode is used mainly for examining the heart. Provides information about the shape of the curves reflecting the amplitude and speed of movement of cardiac structures.

Doppler study. Doppler echocardiography can measure blood flow velocity and turbulence.

In recent years, the combination of sonography and Doppler sonography (duplex sonography) has acquired particular importance. With it, both an image of the vessels (anatomical information) and a recording of the blood flow curve in them are obtained (physiological information).

There is no doubt that the future belongs to radiation diagnostics in improving the quality and level of diagnostic work, reducing the time of diagnostic studies. At the same time, I would like to especially emphasize that the importance of other diagnostic methods: instrumental, endoscopic, etc. is no less important. The art of diagnostics is not in opposing and prioritizing some research method, but in the ability to choose the most appropriate, informative diagnostic method in each specific case. And often this is one of the methods related to radiation diagnostics.

It is necessary to note the main problems of radiation diagnostics at the present time: lack of material and technical base both for training specialists and for purchasing equipment that meets modern diagnostic requirements; the current education system in the field of radiation diagnostics and radiation therapy does not provide adequate training for a qualified specialist; lack of your own clinic; weak technical base, significant radiation exposure; low diagnostic level; outdated organizational and methodological schemes of work and educational and methodological programs; combination of brilliant modern tomography technology with outdated X-ray diagnostic equipment

CONCLUSIONS

1. It is necessary to update the outdated organizational and methodological schemes of work, since in our country the interest in traditional radiology remains at a low level.
2. With the current status of training a radiologist (radiation diagnostician), it is difficult to teach him all modern methods of radiation diagnostics, so the principle of training should be the basis for the reform of postgraduate education.
3. The problem of comprehensive diagnostics and comprehensive education cannot be solved without fully equipping the department of radiological diagnostics in medical institutions and clinics of medical universities with 400 beds and more. In addition to traditional X-ray rooms, ultrasound rooms, lithotripsy units, modern angiographic complexes, CT and MRI are needed.

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