To the 115th anniversary of Russian radiology

THE HISTORY OF THE DEVELOPMENT OF RADIATION THERAPY: RADIATION DIAGNOSIS IN THE MRRC THEM. A.F. TSYBA

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In 2018, Russian radiology celebrated its 115th anniversary. The history began in 1903, along with the foundation of first Russian Department of Radiation Oncology at the Institute named after Morozov (now P. Hertsen Moscow Oncology Research Center). For this event, staff of the FSBI NMRRC of the Ministry of Health of the Russian Federation and a number of other healthcare organizations prepared a series of op-ed articles on the development and success of the clinical use of radiology in our country.

In this article, the authors propose to get acquainted with the history of the development of ray diagnostics in one of the largest Russian radiological centers – A. TSYB MRRC. Since the foundation of the Institute of Medical Radiology, USSR Academy of Medical Sciences (IMR AMS USSR), academician G.A. Zedgenidze organized a ray diagnostics service, that was one of the most advanced in those times in our country, both in terms of equipment and qualifications of experts. Currently, Ray Diagnostics Department at A. Tsyb MRRC continues to bear a banner of one of the best in Russia. Modern diagnostic tools installed in the departments allow to detect neoplasms in the initial stage of development, which, on the one hand, ensures high response to the therapy and relapse-free survival, and on the other hand, diagnosis of cases of negative changes of course of disease. In many respects, thanks to the high qualification and well-coordinated work of the team of doctors, medical scientists from clinical and experimental sectors of the Center, the existing methods are improved, new recommendations and protocols of ray diagnostics research are being developed and actively implemented.

"The scientist's vision is limited to their instruments."
Niels Bohr

К 115-летию отечественной радиологии

ИСТОРИЯ РАЗВИТИЯ ЛУЧЕВОЙ ТЕРАПИИ: ЛУЧЕВАЯ ДИАГНОСТИКА В МРНЦ ИМ. А.Ф. ЦЫБА

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Ray diagnostics is one of the main and most frequently used methods for oncology diseases diagnosis. The existence of cancer service and its further development without diagnostic radiology methods is impossible. Radiological methods are an important link in modern anticancer therapy and are used to determine neoplasm localization, its stage, and also to monitor response to the treatment. In other words, the examination of patient as they admit the medical institution begins with ray diagnostics and, based on the results of imaging, the decision on discharge is made.

The Institute of Medical Radiology, USSR Academy of Medical Sciences (IMR AMS USSR) was created as the largest oncological institute. 1962 is considered to be the year of the institute foundation, since it was precisely that year that the Order of the Minister of Health of the USSR of September 1 on the organization of the Institute of Medical Radiology was issued, and the construction of the experimental sector building was completed. However, the Decree of the CPSU Central Committee and the Council of Ministers of the USSR on the construction of the institute was adopted in August 1958, at the same time the Soviet radiologist, academician of AMS USSR (1960) Georgy Artemyevich Zedgenidze, was appointed to director of the future Institute of Medical Radiology. In 1970, the Institute was renamed to the Scientific Research Institute of Medical Radiology, and since 1992, the Medical Radiological Research Center. Today it is A.F. Tsyb Medical Radiological Research Center, which since 2014 is a branch National Medical Research Radiological Center of the Ministry of Health of the Russian Federation (as amended by the Ministry of Health of the Russian Federation Order of July 12, 2017 No. 427).

In the introduction of the textbook for students of medical universities "On teaching radiology in medical institutes" written by G.A. Zedgenidze in collaboration with L.D. Lindenbraten, the authors note that "... the textbook is made up taking into account the current level of development of science and medical practice..." The introduction states that medical radiology is divided into four main sections: 1) general radiology; 2) X-ray diagnosis; 3) radiologic diagnosis; 4) radiation therapy (radiotherapy). In accordance with them, Department of Radiology in the clinical sector of IMR USSR was created, which included X-ray Diagnosis Department and Radiologic Diagnosis Department. Department of Radiology was headed by G.A. Zedgenidze, and Radiologic Diagnosis Department – M.N. Fateeva.

Over time, medical diagnostic equipment was improved and the Center installed new equipment, which was based on modern physical methods of imaging, therefore, since 2006, Department of Radiology has been expanded and renamed to Ray Diagnostics Department (Head is Z.N. Shavladze, Candidate of Medical Science). The department has the following departments: X-ray diagnosis, ultrasonic diagnosis (Professor V.S. Parshin), radionuclide diagnostics (G. A. Davydov, Candidate of Medical Science), computer-assisted diagnosis (N.K. Silantyeva, Doctor of Medical Science) and MR imaging (Z.N. Shavladze, Candidate of Medical Science).

However, despite the rapid development of modern methods of ray diagnostics, classical X-ray apparatus have the most widespread use. Traditional X-ray radiography remains one of the popular methods, as before, although more than 100 years have passed since its first use.

Since the foundation of the Institute, X-ray Diagnosis Department has been part of the staff of the Department of Radiology. From the very beginning of its organization, the work was divided into several directions. Responsibility for X-ray diagnosis of respiratory diseases was assigned to I.S. Amosov, with the direct participation of whom X-ray stand "Rentpolygraph VRP-2/4" , designed to study the function of the external respiration of a man, was developed. Thanks to I.S. Amosov works, X-ray methods for studying lungs and heart functional status were created, methods of X-ray pneumopolygraphy and X-ray tetragraphy, which allow to simultaneously study both lung tissue respiratory capacity and contribution of tidal volumes to the gas exchange process, were developed and implemented. The description of the developed methods of X-ray diagnosis has been repeatedly published in scientific journals and guidelines. The study of pathologies of the gastrointestinal tract was headed by P.V. Vlasov – co-author of the monograph "Relief of the gastric mucosa in health and disease." Responsibility for the study of the musculoskeletal system was assigned to M.D. Saidov, who published scientific articles on X-ray diagnosis of bone neoplasms and congenital skeletal system defects throughout his short work period. X-ray examinations of urological and gynecological diseases were V.A. Kulikov prerogative. He is a co-author of monographs and guidelines, the most important of which are: "X-ray examination

of laboratory animals" , "Ray diagnostics and radiation therapy of bladder cancer" , "Intravenous angiography in kidney disease diagnosis, accompanied by hypertension" , "Vesiculography for prostate cancer."

In 1973, V.A. Kulikov was appointed to the Head of X-ray Diagnosis Department, and I.S. Amosov became the Head of the department.

A significant contribution to organization of Ray Diagnostics Department, its offices, provision of departments with medical equipment, development and introduction of new methods of X-ray examination of organs and systems were made by professors I.S. Amosov, V.A. Kulikov, P.V. Vlasov, P.M. Kotlyarov; Doctors of Medical Science Yu.G. Elashov, B.M. Astapov, V.A. Degtyarev, P.V. Zharkov; Candidates of Medical Science N.V. Afanasova, Yu.N. Konstantinov.

As remembered by the Center staff, Yu. G. Elashov, Doctor of Medical Science, helped employees of different departments, not only radiologists, but also applicants from the union republics in preparing and defending dissertations during all the years of work at the Institute.

Under V.A. Kulikov, The staff of X-ray Diagnosis Department issued more than 120 scientific publications, including 2 monographs (in co-authorship), obtained 2 patents for inventions. He was a dissertation advisor of 7 PhD theses, that were defended.

Throughout the history of MRRC development, there is a constant improvement in the existing methods and introduction of new methods and devices for ray diagnostics, which significantly expands the possibilities of imaging. Today, one of the main tasks of diagnostic radiology is the introduction of modern diagnostic methods and the timely updating of medical equipment fleet.

Since 90s a new stage is beginning at the Medical Radiological Research Center, connected with the introduction of modern imaging methods. Under the Center modernization programme, X-ray computed tomography (CT) equipment was purchased and in 1991 a same-name department was organized, which was headed by N.K. Silantyeva, Candidate of Medical Science. Computed Tomography Department is actively involved in scientific work, scientific articles and monographs are published.

In 2006, a Magnetic Resonance Imaging (MRI) Department was organized in the Center under the supervision of Z.N. Shavladze, Candidate of Medical Science. Professor T.P. Berezovskaya, Doctor of Medical Science, has been working in the Department since its foundation. Under T.P. Berezovskaya, minimally invasive therapeutic and diagnostic interventions are being actively implemented under the control of computed tomography (CT) and MRI, MR-angiography sect is being developed.

The introduction and widespread use of modern imaging methods such as CT and MRI has expanded the possibilities of oncology diseases verification.

Radionuclide Diagnostics Department is of particular historic importance in the activities of the entire Center. Initially, the department was created as a laboratory of radiologic research methods within Radiologic Diagnosis Department, founded in 1962. The first Head of Radiologic Diagnosis Department was Professor M.N. Fateeva, who stood at the very beginning of Russian radionuclide diagnostics. Later, from 1969 to 1976, the department was headed by Professor R.I. Gabunia; from 1976 to 1998 – Professor E.G. Matveenko, and in 1998–2005. – G.A. Davydov, Candidate of Medical Science. In 2005, the laboratory of radiologic research methods became part of Ray Diagnostics Department and was renamed to Radionuclide Diagnostics Department, which has been headed by G.A. Davydov until now.

Professor M.N. Fateeva and her students gave a theoretical justification for the principles and methods of radionuclide diagnostics in various fields of medicine: endocrinology, oncology, gastroenterology, cardiology, pneumology, uronephrology, osteology and others, which were introduced into clinical practice along with the expansion of radioisotope diagnostics laboratories network in the country.

An important feature radionuclide diagnostics development in our Center is the constant conduct of experimental and clinical research. Thanks to the activities of the department, more than 60 methods of radionuclide diagnostics were developed and improved, for the introduction into clinical practice of which 50 medals of VDNKh (All-Union Exhibition of Achievements of National Economy) USSR were received, including 6 gold, 9 silver and 35 bronze. The results of scientific research papers of the department staff are summarized and published in the form of 13 monographs, 7 collections, 25 guidelines and over 500 articles, 47 invention certificates were received. Over the entire period of department's activities, 10 doctors and 35 candidates of science were trained, many of whom became heads of institutes and laboratories in Russia and CIS countries.

In recent years, employees have published more than 100 scientific articles, participated in writing of several monographs and manuals.

Ultrasonic Diagnosis Department was founded in 1988 on the basis of existing Lymphangiography Department due to the fact that by that time ultrasound tomographs made up a body of the diagnostic equipment. In turn, the history of Lymphangiography Department began on the basis of the group of lymphangiography, which was organized and successfully supervised by A.F. Tsyb. In Lymphangiography Department, X-ray semiotics of neoplasms was and the processes of recurrence and progression of malignant tumors after antineoplastic therapy were studied, and the morphological and functional changes that occurred after radiation and combined therapy of cancer were determined. Methods for the study of lymphatic system using various diagnostic techniques were developed.

A temporary international team of countries of the Council for Mutual Economic Assistance on Lymphangiography was formed and effectively worked on the basis of the department; methods and devices for conducting lymphography were developed. Fundamental X-ray findings on the anatomy and function of thoracic duct and other parts of the lymphatic system were obtained. The technique of total intravital microangiography was developed.

The following doctors successfully worked in the department: B.Ya. Drozdovsky, O.V. Nestayko, G.V. Chepelenko, A.P. Kislitsyn, V.I. Strigunov, V.V. Yarzutkin, O.N. Ostapovich, I.Kh. Mukhamedzhanov, A.I. Dergachev, V.S. Parshin and G.N. Grishin.

From 1988 to 2006, the former Director of MRRC, Academician A.F. Tsyb, was the eternal Head of Ultrasonic Diagnosis Department. He is the author and co-author of over 500 scientific works, including 26 monographs. The most important diagnostic works are the following: "Clinical lymphography" , "Diagnosis and combined treatment of rectal cancer" , "Guidelines for ultrasonic diagnosis of diseases of abdominal organs and retroperitoneal space" , "Ultrasonic tomography and targeted biopsy in diagnosis of pelvic tumors." Under A.F. Tsyb, The department strengthened and developed, new ultrasonic apparatus were purchased. The era of ultrasonic diagnosis has begun at the Center. First doctors worked at the department were A.I. Dergachev, V.S. Parshin, I.Kh. Mukhamedzhanov, G.N. Grishin, S.G. Shakhova.

After technogenic disaster at the Chernobyl Nuclear Power Plant and release of radioiodine into the atmosphere, it became necessary to carry out a screening survey of the population living in contaminated areas. Over the 20-year period, more than 250,000 ultrasonic examinations of thyroid gland were performed, and an organ screening technology for early diagnosis was developed. According to the results of the surveys, many scientific articles and monographs were published, the most important of which is "Thyroid cancer. Ultrasonic diagnosis. Clinical Atlas. On the basis of Chernobyl materials." The research results of the department were included in 2 reports that were presented to the United Nations General Assembly on the medical consequences of Chernobyl accident.

In 2006, Ultrasonic Diagnosis Department was headed by Professor V.S. Parshin. On the basis of the department, 7 doctors and 32 candidates of medical science were trained, 21 monographs were published.

At Ultrasonic Diagnosis Department, in addition to the main work, screening surveys of the population of the Bryansk and Kaluga regions continue under the Government Contract of the Center with the Emergency Control Ministry "The introduction of advanced medical technologies in the diagnosis and treatment of citizens with cancer" and "Screening technology for thyroid gland malignant diseases diagnosis." To enhance practical significance of studies and share experience, the department works closely with doctors from Japanese universities in Nagasaki and Fukushima.

Department of Laser and Photodynamic therapy was founded in 1998. The Head of the department since its first day until now is Professor M.A. Kaplan, Doctor of Medical Science. Under Professor Kaplan, work is underway to study the impact of laser irradiation on biological objects, the development of new laser therapy equipment and photosensitizers for photodynamic therapy, the creation and subsequent introduction into clinical practice of new methods of laser irradiation. A new sect of laser medicine is being developed in the department – photodynamic therapy and fluorescent diagnostics, which are effectively used to diagnose and image foci of skin neoplasms and mucous membranes. The use of domestic alasens and photolon photosensitizers allows the use of the following test – fluorescence spectroscopy with additional imaging of skin tumor lesions. Present test helps to determine boundaries of tumor lesion, which makes it possible to conduct a more definitive course of treatment and reduce the number of so-called marginal recurrences. In the process of diagnostics, it is possible to reveal hidden lesions, as well as monitor the content of medication in skin, the course of the treatment and assess the duration of skin phototoxicity period. The work of the department is carried out in clinical and experimental sects, according to its results, methods of treatment and diagnosis of skin and mucous membranes masses have been developed. The department works closely with the Kaluga branch of S.N. Fedorov NMRC MNTK "Eye Microsurgery" in the field of of development of fluorescent diagnostics and therapy methods in ophthalmology. In addition, photodynamic therapy is used in the treatment of cancer of oral musoca, lower lip, lung, esophagus, stomach and vulva.

In 2018 at A. Tsyb MRRC, Department of X-ray Surgical Diagnostic and Treatment Methods was opened under the supervision of V.V. Kucherov, Candidate of Medical Science. Chemoembolization and radioembolization of liver, unique surgeries for Russia, are performed here. Radioembolization in the treatment of liver cancer and metastases is carried out using domestic microspheres based on yttrium-90 radionuclide.

The introduction of MRRC into the united Center represented by FSBI NMRRC of the Ministry of Health of the Russian Federation expanded the possibilities of introducing into our clinical practice the results of our basic research, opening up new ways to successfully sort out current problems of development and high-quality application of new methods of therapeutic radiology.

The improvement of existing methods, the conduct of experimental and scientific research within the walls of MRRC that promote the introduction of new protocols of ray diagnostics into clinical practice, reinforce the significance and effectiveness of diagnostic radiology in cancer service.