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PRINCIPLES OF RADIATION DIAGNOSTICS

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Abstract
the work examines the basic principles, organizational, methodological and technical conditions of radiation diagnostics. Schematic diagram of obtaining radiological image in blocks and presented a vision of the difference in the image with different radiation methods. Also shown the difference between analogue and digital images of radiology diagnostics.

Keywords: radiation diagnostics, x-ray, radiology, method, analogue, digital, medicine, thermography.

Introduction

The principles of radiation diagnostics are divided into 5 categories:

1. The validity of prescribing and using radiological diagnostic methods for each individual patient, taking into account the clinical situation, indications and contraindications for the study.
2. Use of the most informative and minimally invasive research methods and techniques to obtain the highest possible completeness and quality of diagnostic information.
3. Timeliness of radiological examinations.
4. The economic feasibility of conducting radiation studies in order to eliminate the costs of time and money that are not justified by clinical objectives.
5. The maximum possible reduction in radiation doses to patients and personnel when conducting diagnostic procedures using ionizing radiation.

The implementation of these principles must be ensured by a combination of organizational, methodological and technical conditions. The organizational and methodological conditions for the implementation of the basic principles of radiation diagnostics include [1]:

`- knowledge and application of the principles of standardization of radiation studies;

- active participation of the attending physician and radiology specialist in determining indications for conducting studies using sources of ionizing radiation;
- when choosing a diagnostic algorithm in each specific situation, mandatory consideration and differentiated inclusion of those methods that provide maximum diagnostic yield without reducing the quality of diagnosis, with less radiation exposure or its complete elimination;

- maximum use during the research of protective equipment for anatomically adjacent organs and systems of the patient;
- constant improvement of the level of knowledge of doctors and laboratory assistants in matters of radiation safety;
- maximum reduction of duplication of similar studies;
- rational construction of research technology in order to reduce defects: working with automatic developing machines, proper use of protective equipment, automatic exposure meters, highly sensitive receivers and image converters;
- registration and accounting of the received effective dose.

The technical conditions for the implementation of the principles of radiation diagnostics are:
- ensuring the operability of radiation diagnostic devices (timely service and repair, metrological support, radiation monitoring);
- use of modern technological solutions that provide informative medical images with minimal radiation exposure (digital solid-state matrix detectors for X-ray diagnostics, multispiral technologies for computed tomography scanning and post-processing, etc.).

A radiological image is understood as a visually perceptible distribution of radiation of any kind, converted into an optical range that displays the structure and function of a biological object. Images are created by special systems. Their purpose is to make non-visual information accessible to visual perception [2].

All imaging radiological systems: X-ray, radionuclide, ultrasound, thermographic, magnetic resonance - can be represented in the form of a circuit diagram (Fig. 1).

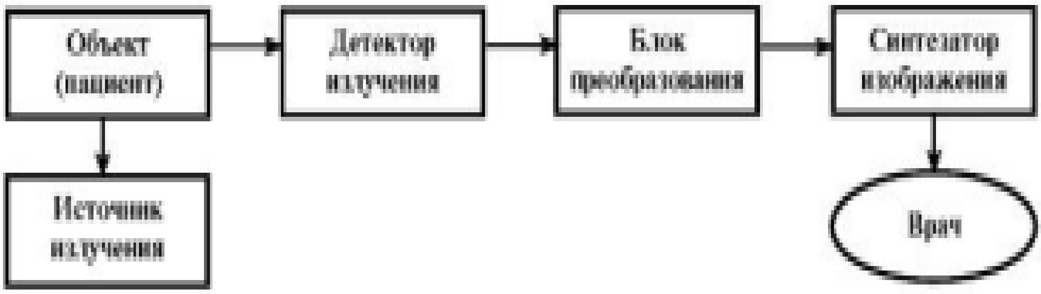

Fig. 1. Schematic diagram of obtaining a radiological image

The first block in this circuit is the radiation source. It may be located outside the patient, such as during X-ray and ultrasound examinations. It can be introduced into the body, as in radionuclide studies. Radiation can be generated in the human body spontaneously (with thermography) or due to external excitation (with magnetic resonance imaging).

The next block in the beam imaging system is the radiation detector. It interacts indirectly with the observed object. Its purpose is to capture electromagnetic radiation or elastic vibrations and convert them into diagnostic information. Depending on the type of radiation, the detector can be a fluorescent screen, photographic film or x-ray film, a gas discharge chamber or a scintillation sensor, special materials and alloys, etc.

In some systems, information signals from the detector enter the video signal conversion and transmission unit. The purpose of this block is to increase the information capacity of the signal, remove interference ("noise"), and convert it into a form convenient for further transmission. Conversions of video signals can be reduced to changing their physical nature (for example, converting elastic vibrations or light radiation into electrical signals) or involve mathematical processing in order to change their structure.

The converted signals are then passed to an image synthesizer. It creates an image of the object under study - an organ, part of the body, the whole person.

Of course, with different radiation methods the image will be completely different:

- Radiographs reveal to us mainly the macromorphology of organs and systems, and also allow us to judge their function at the organ level.
- Radionuclide scintigrams enrich us with information about the function of tissues and cells, i.e., they primarily reflect the functional anatomy of a person.
- Ultrasound allows us to judge the structure and function of organs by analyzing their acoustic structure.
- Thermography is a method for assessing the human thermal field. Radiation examinations are planned and performed by a radiology diagnostician [3].

A doctor who has received special training in radiology diagnostics. Its activity consists of receiving visual information, processing it, interpreting the results and making a diagnostic decision. A doctor of any profile has to deal with materials from radiation diagnostic studies: radiographs, scintigrams, sonograms, thermograms, computed tomograms, etc.

Consequently, every doctor must have basic information that will allow him, when consulting a specialist in diagnostic radiology or with the help of his conclusion, to correctly perceive the results of radiation studies and evaluate their significance for recognizing the disease and treating the patient.

General rules for studying any medical diagnostic image can be summarized as follows:

I. General inspection of the image:

1) determination of the applied radiation technique;

2) identification of the object of study (part of the body, organ);

3) general assessment of the shape, size, structure and function of the body part (organ) being studied.

II. Detailed study of the image:

1) differentiation between "norm" and "pathological condition";

2) identification and assessment of radiation signs of the disease;

3) attribution of the sum of detected signs to a specific clinical syndrome or general pathological process.

III. Delineation of diseases that cause an established syndrome and (or) pathological process.

IV. Comparison of images of the organ obtained from different radiation studies.

V. Comparison of the results of radiological studies with data from other clinical, instrumental and laboratory studies (clinical radiological analysis and synthesis).

VI. Formulation of a conclusion based on the data of radiological studies. The analysis of the beam image should begin with an image of the whole picture as a whole, without first fixing attention on any detail, even bright and seemingly very important. Having determined the research technique (x-ray, sonography, scintigraphy, etc.) and established which part of the body was examined, you need to correctly position the image in front of you [4-5].

When determining the size and shape of the organ (body part) being studied, the projection of the study is also established - straight, lateral, oblique, axial. During a general examination, the images obtain the first approximate idea of the state of the object under study. When further studying the details of the radiation picture, the doctor always compares the visible images with the "norm" standard. Everything that deviates from the usual "average" picture should be analyzed and regarded either as a variant of the norm or as a manifestation of pathological changes. The found pathological changes are then assessed within the framework of the whole picture, i.e. a reverse transition is made - from the particular to the general. This allows us to attribute the identified symptoms to a specific syndrome or general pathological process (inflammation, damage, tumor, etc.).

Next, the doctor, guided by knowledge of the basics of pathology and the sum of the obtained radiation and clinical data, distinguishes between diseases that can cause this pathological process. The entire variety of medical radiation images, regardless of how they are obtained, can be reduced to analogue and digital images.

Analogue images include those that carry continuous information. These are images on ordinary radiographs, scintigrams, thermograms.

Digital images include those produced using a computer. They have a cellular structure (matrix), represented in the computer memory. Digital images are images obtained using computed tomography, digital radiography, fluoroscopy and angiography, MR imaging, computer scintigraphy with computer information processing, digital thermography, and ultrasound scanning.

Thus, digital images, unlike analogue ones, have the property of discreteness. Since digital images are based on computer technology, they become available for computer processing. Analog images can be converted to digital, and vice versa, digital to analog. For these purposes, special devices are used: analog-to-digital and digital-to-analog converters.

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