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CLASSIFICATION OF MRI

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Abstract
The work considers the design of the MRI tomography apparatus and the general algorithm for conducting MRI studies. It is shown that MRI studies take 30-60 minutes, where it is also possible to use systems for monitoring vital functions and lung ventilation. Depending on the structure of the medical organization, the conclusion and images are given to the patient or transferred to the attending physician.

Keywords: MRI, tomography, resonance, classifier, design, superconductivity, X-ray technician, radiologist.

Introduction

Magnetic resonance imaging is a modern method of medical imaging based on the phenomenon of nuclear magnetic resonance. Although MRI is a type of radiation diagnostics, unlike X-ray imaging methods, it does not involve the use of ionizing radiation.

The main factors in action are the constant magnetic field and the electromagnetic fields that vary in time and space.

Depending on the value of the magnetic induction of the static magnetic field, MRI scanners are usually classified as:

– ultra-low field (less than 0.1 T);
– low-field (0.1–0.3 T);
– medium-field (0.3–0.5 T);
– high-field (0.5–3 T);
– ultra-high-field (over 3 T).

Fig. 1. Magnetic resonance imaging scanner MR 5300 from the Dutch company Philips

By design, the devices are divided into open and closed type MRI scanners. However, in the context of developing design documentation, another classification should be taken into account - by the type of the main source of the magnetic field:

- permanent;
- resistive;
- superconducting;
– hybrid systems.

Ultra -low-field and low-field tomographs typically use permanent magnets, which do not require cooling or constant power supply during operation.

In resistive tomographs, the field is created by passing an electric current through a coil. This method allows for the creation of a constant magnetic field with an induction of up to 0.6 T, but it requires cooling and a constant power supply to maintain uniformity. field strength.

The most common tomographs today are those with superconducting magnets that generate a magnetic field with an induction of 1.5 and 3 T. Such magnets provide high homogeneity and stability of the magnetic field.

Superconductivity is achieved by placing a conducting coil in a Dewar flask and cooling it with a cryogen (usually helium) to a temperature of about 4 K (–269 °C).

It should be noted that the procedure for conducting an MRI examination is not limited to the process of "scanning the patient" and also includes a number of mandatory actions before and after it.

Regulation and standardization of the use of MRI scanners in clinical practice is beyond the scope of these recommendations, however, the authors believe it is appropriate to provide a brief algorithm of actions for MRI room personnel when conducting an MRI study, which is as follows:

General algorithm for conducting MRI examination

The main interaction with the patient during the examination is carried out by the X-ray technician of the MRI room. In general, the following procedure is followed:

1. Checking for previous studies.
2. Patient identification.
3. Communication with the patient (description of the procedure, reassurance).
4. Determination of anthropometric parameters (height and weight).
5. Information and survey.
6. Filling out the questionnaire.
7. Changing clothes.
8. Scanning for metal objects.
9. Positioning the patient using appropriate RF coils and sensors.
10. Checking the functionality of audio and video communication systems, instructions same on the use of the "panic button".
11. Insertion of a catheter (in case of a study with contrast).
12. Conducting the research.
13. Changing clothes.

As a rule, the operator of the MRI scanner is also a radiologist , but when scanning complex patients, the protocol settings can be performed by a radiologist together with a medical physicist (engineer).

The duration of an MRI examination is usually 30-60 minutes, depending on the purpose (short examinations - from 15 minutes). In some cases, an accompanying person may be present in the procedure room.

When conducting a study on immobile or unconscious patients, additional time is required for examination and positioning, preliminary CT or X-ray. Vital function monitoring systems, lung ventilation, etc. can also be used.

After the examination, the radiologist analyzes and describes the obtained images at the doctor's workstation (can be located remotely).

Depending on the structure of the medical organization, the conclusion and images are given to the patient or transferred to the attending physician, as a rule, the next day after the examination.

Fig. 2. Modular prefabricated building for tomography

The main risk factors that arise in the MRI room include:

– the impact of MRI fields on products made of ferromagnetic materials (possible consequences: retraction, rotation, heating);

– the danger of the release of the superconducting magnet coolant (the so-called quench);

– the impact of fields generated during the operation of the MRI scanner on incompatible equipment (pacemakers and rhythm drivers, X-rays) Novo tubes, communication equipment, etc.).

Each of these factors may result in equipment failure, injury, or death.

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