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DETECTION OF NODULAR FORMATIONS IN THE MAMMARY GLAND USING MRI: MODERN APPROACHES AND POSSIBILITIES

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Abstract: Magnetic resonance imaging (MRI) is a modern, highly informative method for diagnosing nodular lesions in the mammary gland. This method is especially effective in cases where mammography and ultrasound do not provide unambiguous results. MRI allows one to differentiate benign and malignant tumors, assess tissue changes, and detect tumors at early stages. The article discusses the main advantages of MRI, its operating principles, indications for use, as well as limitations and possible difficulties associated with this method. Despite some shortcomings, MRI remains an important tool for diagnosing and monitoring breast diseases.

Key words: Magnetic resonance imaging, MRI of the mammary gland, nodular formations, cancer diagnostics, tumors, mammary gland, contrast agent, visualization, diagnostic methods, oncology.

Introduction. Magnetic resonance imaging (MRI) is one of the most accurate and safe methods for diagnosing nodular lesions in the mammary gland. High spatial resolution and soft tissue contrast make this method indispensable in assessing the morphological and functional characteristics of tumors. Modern protocols for MRI of the mammary gland include dynamic contrast enhancement (DCE-MRI), diffusion-weighted imaging (DWI) and spectroscopy, which allows not only to detect neoplasms, but also to determine their biological nature.

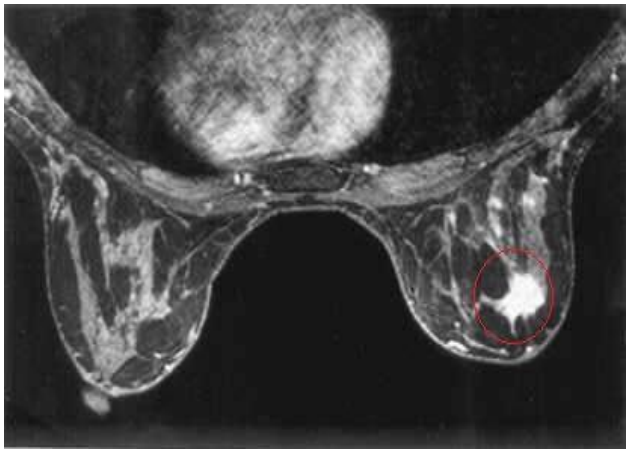

Figure 1. MRI of the mammary gland with contrast enhancement

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Advantages and features of MRI of the mammary gland

MRI is superior to traditional diagnostic methods (mammography and ultrasound) in cases of:

• High density of breast tissue, when mammography is uninformative.

• Ambiguous results of other diagnostic methods.

• Suspected multifocal or multicentric cancer.

• Evaluation of the effectiveness of chemotherapy.

One of the key advantages of MRI is the ability to detect changes in vascularization and differentiate benign and malignant tumors.

Figure 2. MRI (a) and mammography (b) of breast cancer

How MRI works

MRI is based on the phenomenon of nuclear magnetic resonance, in which hydrogen nuclei in tissues interact with a magnetic field and radiofrequency pulses to emit signals that form an image.

In the context of breast diagnostics the following are used:

• T1-weighted images – for anatomical visualization.

• T2-weighted images – to assess tissue structure and detect edema.

• DCE-MRI (dynamic contrast enhancement) – to assess tumor vascularization .

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• DWI (diffusion-weighted imaging) – to determine cell density.

The use of gadolinium-based contrast agents significantly increases the sensitivity of the method.

Indications for MRI of the mammary gland

Key indications include:

• Suspected cancer with dense breast tissue structure.

• Assessment of the extent of tumor spread before surgical treatment.

• Monitoring patients after organ-preserving surgeries.

• Screening of women at high risk (carriers of BRCA1 and BRCA2 mutations).

Materials and methods

Materials

The study used data from women who underwent breast MRI scans. The studies were conducted on a [GE HealthCare] with magnetic field strength [1.5 T].

Methods

• T1-, T2-weighted, DWI and DCE-MRI sequences were used.

• A gadolinium-based contrast agent was used.

• Image analysis was performed by two independent radiologists.

MRI technique

The procedure took 20–40 minutes. Patients were placed in a prone position in a special breast coil. In the case of contrast enhancement, the drug was administered intravenously, after which dynamic sequences were performed. It is important to remain still during the scan, as motion artifacts can reduce image quality .

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Limitations and possible difficulties

Despite its high information content, MRI has limitations:

• Limited availability of equipment in small medical centers.

• High cost of examination.

• Possible contraindications to contrast (allergy, renal failure).

• Motion artifacts may reduce image quality.

Conclusion. MRI is one of the most accurate methods for diagnosing nodular formations in the mammary gland. The use of modern visualization protocols (DCE - MRI , DWI) allows not only to detect tumors, but also to assess their malignancy. Despite its limitations, the method remains a key tool in the early diagnosis and monitoring of breast cancer.

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