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ROLE OF DIGITAL TOMOSYNTHESIS IN THE DIAGNOSIS OF EARLY BREAST CANCER (LITERATURE REVIEW)

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Abstract:

RELEVANCE. Among oncological diseases, breast cancer (BC) in women occupies a leading place throughout the world. There have been advances in its treatment, but early diagnosis of breast cancer is limited by the capabilities of X-ray mammography and ultrasound and therefore often requires additional methods for examining the mammary glands.

Keywords:

THE PURPOSE OF THE STUDY is to summarize and analyze the available data on modern radiation methods of additional visualization of the mammary glands, used to improve early breast cancer using digital tom synthesis

MATERIAL AND METHODS.

The review includes data from randomized controlled trials (RCTs) and meta-analyses on the effectiveness of breast imaging methods in the early diagnosis of breast cancer, published over the past 15 years. Survival rates for patients with breast cancer directly depend on the stage of the disease at the time of diagnosis. 5-year survival rates in patients with stage 0 and I breast cancer are close to 100%, in patients with stage II the disease decreases to 93%, and in stage III – to 72%. At stage IV, survival rate decreases to 22%. The main cause of unfavorable outcomes of cancer is metastasis. It is important to understand that breast cancer (BC) is a diverse disease with different pathogenetic features. There are several pathogenetic varieties of breast cancer, which differ significantly in epidemiology, risk factors, biological behavior, response to treatment and prognosis. Biologically distinct forms of breast cancer (BC) have a direct impact on screening results and the effectiveness of treatment for this disease. Each type of breast cancer may have its own unique characteristics, such as the rate of tumor growth, sensitivity to treatment, and the likelihood of recurrence. These differences may influence the success of diagnosis and treatment, as well as patient outcomes. It is therefore important to consider the biological diversity of breast cancer when developing screening, diagnosis and treatment strategies to ensure optimal outcomes for all patients .

Currently, mammography is the only method that has been shown to reduce breast cancer mortality in women aged 50 years and older. However, in women aged 40 to 49 years, evidence of the effect of mammography on breast cancer mortality is considered limited. This is due to the higher prevalence of dense breast tissue in this age group, which reduces the sensitivity of the method to 50.0% - 68.1% compared to 85.7% - 88.8% in women with fatty breast tissue. Dense breast tissue may be associated with an increased relative risk of breast cancer of up to 4.6 in premenopausal women and up to 3.9 in postmenopausal women. This is because high breast tissue density is often associated with fibrocystic disease, which may be a precancerous condition, or with other risk factors for breast cancer .

Digital mammography (DMG), magnetic resonance imaging (MRI) and multipara metric ultrasound (US) are the main gold methods for diagnosing breast cancer [7,8,9,11]. But their capabilities in determining the small size of breast cancer (the presence of a pathological focus with a diameter of no more than 10 mm in diameter or visualization of grouped accumulations of malignant micro calcifications numbering more than 15 pieces per 1 cm2 of breast tissue) can be said to be limited [3,4,23]. In practice, one of the most unfavorable consequences of the lack of reliability of MMG, ultrasound and MRI is the high rate of invasive interventions in the form of excisional breast biopsies [1,5,6,10,21].

Until now, mammography is considered the main method for detecting tumors in the mammary gland (MG), both in early diagnosis and in screening. However, the accuracy of mammography is significantly reduced in differential diagnosis, especially when tissue density is very high, particularly when detecting minimal breast cancer. [3,15,17,19]. The most significant factor noted by researchers is breast tissue density. According to Woolston C et al, the sensitivity of mammography decreases from 80 to 30% in patients with high breast density. Therefore, numerous attempts have been made to complement mammography with other research methods in order to increase the detection of breast cancer against the background of dense

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parenchyma. It is interesting to note that the results of randomized trials show that the use of mammography as a screening method for breast cancer does not significantly increase overall life expectancy in patients. It should be noted that women included in the control groups of such studies are usually well aware of the early signs of breast cancer and follow doctors' recommendations about breast self-fingerling and undergoing regular preventive examinations.

Ultrasound (US) plays an important role in the diagnosis of early breast cancer. Unlike mammography, which is often ineffective in cases where tissue or breast density is high, ultrasound may be more sensitive in detecting early changes in breast tissue. Ultrasound is also useful in assessing the texture and structure of the tumor, its size, and its relationship to surrounding tissue. In addition, ultrasound can help guide a guided biopsy, which can provide a tissue sample for further analysis without the need for surgery. Thus, ultrasound is an important tool in the diagnosis of early breast cancer and can complement data obtained using other methods such as mammography and clinical examination [12,13,16] .

Computed tomography (CT) is not usually used as the primary method for diagnosing breast cancer due to its limited sensitivity to early changes in breast tissue. Mammography, ultrasound, and magnetic resonance imaging (MRI) are usually the preferred methods for detecting breast cancer.

However, sometimes CT scanning can be used in addition to other methods of diagnosing breast cancer, especially in cases where there is suspicion that cancer cells have spread to other organs (metastasis). CT scans can help determine the location and size of metastases in the lungs, liver, bones or other organs, which helps determine the stage of breast cancer and develop a treatment plan. However, it is important to remember that CT scans are not ideal for diagnosing breast cancer and are usually used in combination with other more specialized techniques.

There is currently an increasing number of studies comparing contrast-enhanced mammography with image synthesis (CESM) and magnetic resonance imaging (MRI). According to data [15,18], CESM is not inferior to MRI in determining the size of the primary tumor. Some scientists have proven that there are no significant differences in determining the multicentricity and multifocality of a malignant process in the mammary glands. In this regard, CESM is increasingly being considered as an alternative to MRI. The authors of several scientific papers reported patient preferences that 79% of respondents would prefer CESM, provided that both methods had the same sensitivity. In addition, 89% of respondents expressed willingness to undergo CESM as an annual screening examination [1,5,8].

Magnetic resonance imaging (MRI) plays an important role in the diagnosis of breast cancer, especially in addition to other methods such as mammography and ultrasound. MRI may be especially useful in the following cases:

1. In women with a high genetic risk of developing breast cancer, especially if they have mutations in the BRCA1 and BRCA2 genes.
2. To assess the spread of breast cancer before surgical treatment, as well as for planning surgery.
3. When diagnosing breast cancer in young women or when there is dense breast tissue, when mammography may be less effective.
4. To detect hidden tumors or multiple tumors that may be missed by other methods [15,18,19].

MRI provides additional information about the structure and characteristics of the tumor, which helps in making treatment decisions and planning surgical interventions. However, it should be remembered that MRI is not an ideal method for screening breast cancer due to its high sensitivity and low specificity, as well as the possibility of false-positive results. In a retrospective study of 650 patients with high risk breast cancer, MRI showed a sensitivity of 92.3%, compared with 30.8% for mammography, but specificity was only 85.9%, compared with 96.8% for mammography. mammography. In this study, of the 13 cases of breast cancer detected, the diagnosis was made based on MRI findings in only 9 patients.

In another Canadian study, which assessed the effectiveness of various methods for diagnosing breast cancer in carriers of BRCA1 and BRCA2 mutations, out of 236 women, 16 cases of invasive breast cancer and 6 cases of ductal carcinoma were found in situ . In 17 patients (77%) the disease was detected by MRI, in 8 (26%) by mammography, in 7 (33%) by ultrasound, and in 2 (9.1%) by clinical examination. These results show that in patients at high risk of developing breast cancer, breast MRI has the highest effectiveness

The effectiveness of radiation diagnostic methods (mammography, ultrasound) in patients with multi centric breast cancer ranges from 41% to 56% [19,20,21]. Therefore, the search for new informative methods for detecting this type of cancer is an important task. The development of effective methods for diagnosing multi centric breast cancer is important for clinical practice. The dense background of the mammary gland requires the use of additional

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examination methods, such as tom synthesis, ultrasound (US) and magnetic resonance imaging (MRI). Since the beginning of the 2010s, a new type of X-ray method for examining the mammary glands has appeared in the practice of radiologists around the world. Therefore, further research is needed to determine the optimal screening plan for patients for early detection of minimal and multi centric breast cancer.

The role of positron emission tomography/computed tomography (PET/CT) in the diagnosis of early breast cancer (BC) remains unclear, and the information content of such studies in patients with non-palpable tumors is extremely low. The study performed positron emission tomography/computed tomography (PET/CT) on 54 patients with positive mammography for differential diagnosis. Subsequently, all patients underwent a biopsy. PET/CT results were positive only in 9 (81.8%) of 11 patients with established invasive breast cancer and in 3 (20%) of 15 with non-invasive breast cancer. No false positive results were found. However, a key problem in using this method for diagnosing early breast cancer is the different level of radiotracer uptake among different histological types of breast cancer [3,5]

The practical application of tom synthesis (TS), a new technique for additional examination of the mammary glands, can help avoid these problems (Sidky EY et al., 2009). Recently, in many countries of Western Europe and the United States, the use of combined 2D + 3D imaging to detect pathologies of the mammary glands (where 2D is two-dimensional mammography, and 3D is tom synthesis of the mammary glands) has become increasingly common[20]. Tom synthesis allows you to create a series of images with different angles of inclination of the X-ray tube, while maintaining compression of the breast, and then convert them into a series of tomograms [1,15,21]. The use of tom synthesis (TS) makes it possible to more accurately assess the qualitative characteristics of nodular formations (shape, size, structure, contours), and sometimes even detect breast lesions that may be missed during conventional mammography [12,13,20]. Preliminary experience in the use of tom synthesis in the radiological diagnosis of breast diseases has shown an increase in the sensitivity of the x-ray method due to additional information obtained in a multi-slice mode, while the examination time practically does not increase, and the radiation dose to the patient does not increase significantly [19,21].

The use of this technique in the differential diagnosis of non-palpable mammary gland formations is described in foreign and domestic literature only in a limited amount of research.

Analysis of literature data confirms the diagnostic potential of radiological diagnostic methods for identifying and clarifying the nature of non-palpable mammary gland formations [20]. Most studies are limited to certain aspects of the operating principle and application of tom synthesis. However, it is assumed that additional diagnosis of the minimum size of breast tumors using tom synthesis can help identify pathology in the early stages, including cases of atypical course of the disease, which will allow establishing the correct diagnosis, determining further treatment tactics for the patient and reducing mortality.

CONCLUSIONS.

Knowledge of the main X-ray and tomographic signs of early breast cancer can allow a radiology specialist to establish a correct diagnosis even for minor forms of the disease, and a clinician to choose a diagnostic and treatment strategy. However, systematization of digital tom synthesis is required for non-invasive and invasive forms of breast cancer, which allows optimizing the algorithm for examining patients with suspected breast cancer.

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