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STUDIES OF PATIENTS WITH NON-PALPABLE BREAST LOCATIONS USING X-RAY MAMMOGRAPHY

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ABSTRACT

Mammography is the only method for diagnosing mammary gland calcifications, which can be the primary and only sign of an incipient malignant process. Using digital X-ray mammography, patients were diagnosed with non-palpable breast cancer in which nodular formations were not detected during palpation. X-ray density of the mammary glands was assessed using the BI-RADS system (Breast Imaging Reporting and Data System. The results obtained confirm that digital X-ray mammography has made it possible to create on its basis two methods for studying the mammary glands, which are becoming widespread in the diagnosis of breast cancer patients **with** non-palpable breast formations.

Keywords: Mammography, X-ray, digital analysis, radiology, category, classification, calcification, tumor.

INTRODUCTION

The history of the development of imaging of breast diseases began in 1913 with the work of Albert Salomon, a German physicist who experimentally studied the effect of X-ray radiation on breast tissue, for which mastectomy samples were used. Salomon was the first to describe the characteristics of tumor nodes, their difference from benign formations, the metacentric variant of tumor growth, as well as micro calcifications in a malignant process.

The X-ray mammography method was not used until the 30s of the twentieth century due to the poor development of equipment, low quality of the resulting image and high dose load [1,2]. Leborgne was published, which more accurately describes the radiological semiotics of benign and malignant diseases of the mammary glands, as well as the connection of the malignant process with micro calcifications, which, according to the author, are present in 30% of tumors [3].

Since the late 50s, Cohen and his associates proposed the concept of screening mammography, but its widespread use began after the publication of the works of Robert Egan in 1960. In 1963-1966, the first randomized controlled trial was conducted to evaluate the effectiveness of periodic screening using physical examination and mammography in reducing mortality from breast cancer. Over 5 years of observation, it was shown that when compared with the control

group, mortality decreased by a third [4, 5]. Screening X-ray mammography is the only diagnostic method that demonstrates a 20-30% reduction in breast cancer mortality with regular screening [6].

Since that time, the development of stereo-assisted preoperative markings and core biopsies began, which are currently an integral method for diagnosing diseases of the mammary glands.

METHODOLOGY

In the diagnosis of breast diseases, the invention of digital X-ray mammography has taken a leading place in the field of diagnosing patients with breast cancer. In contrast, analogue mammography has a number of disadvantages. Thus, obtaining an analogue image consists of fixing the image of an object on X-ray film with points, the density of which reflects the degree of absorption of X-ray radiation by the object. Due to the low quantum parameters of X-ray film, it is necessary to use large doses of ionizing radiation, which increases the radiation dose to the patient. Additionally, the limited brightness range of film makes it difficult to see soft and dense tissue in the same image. Working with film requires a special room for developing and drying it; the accumulated archive requires huge spaces for its storage. Improper storage and care of film leads to damage to photographs, exposure of the film and the appearance of defects and artifacts on it.

Digital X-ray mammography was approved by the FDA in the USA in 2000 quickly became widespread throughout the world and has now almost completely replaced analogue mammography.

Digital X-ray mammography has a number of advantages, allowing you to obtain high-quality images of the mammary glands with a higher contrast resolution and improved dynamic range, is distinguished by the speed of data and image processing compared to film mammography, the ability to transfer images to a doctor's workstation, their long-term storage, and also opens opportunities for remote imaging consultation and telemedicine. Performing digital X-ray mammography requires much less compression of the gland and reduces radiation exposure by 17-22% [6].

The sensitivity of traditional X-ray mammography in detecting breast cancer, according to various authors, is 63-98%, specificity – 90-95%. These indicators are generally the same for digital and analogue mammography and decrease to 30-48% with a dense background of the breast [7] .

It is known that mammography is the only method for diagnosing mammary gland calcifications, which can be the primary and only sign of an incipient malignant process. So in the study by M. Morgan et al. It has been shown that radiologically visible micro calcifications occur in 40% of malignant tumors. In 55% of cases, these are non-palpable tumors of the mammary glands. According to the work of S. Pinder, screening mammography reveals 20-25% of ductal cancer in situ [8]. Performing digital mammography increases the sensitivity of the method in identifying micro calcifications, mainly their intermediate forms (amorphous micro calcifications), which are signs of severe dysplasia and cancer in situ [9].

SURVEY

Before the x-ray examination, the clinical examination of the patients took into account complaints (pain, its nature and intensity, the presence of lumps and formations, changes in the skin and nipple, the presence and nature of discharge from the nipples), medical history (family cancer history, the presence of injuries and operations on the mammary glands, gynecological status, use of hormonal therapy, concomitant diseases).

At the first stage, all patients underwent a physical examination in a standing position with their arms raised up and down. The size, shape, symmetry of the mammary glands, the condition of the skin and nipple - areolar complexes were assessed, and the presence of secretion from the nipples was checked. Then the mammary glands were palpated with arms raised up and down, and, if necessary, in a horizontal position. The axillary region, as well as the supraclavicular and subclavian regions, were necessarily examined for enlarged lymph nodes or other nodular formations.

The study included only patients in whom nodules were not detected on palpation.

X-ray diagnostics research was carried out on an Amulet digital mammography system (Fujifilm, Japan), with a direct conversion flat panel detector (FPD) with a pixel resolution of 50 μm. The dimensions of the detector were 24x30cm. The resulting image was automatically transmitted to a radiological information station with Vidar software.

Mammography for each breast was performed in two standard projections: direct (craniocaudally CC) and oblique (lateromedially MLO). If necessary, the study was supplemented with images in the lateral projection (latera -medial LM) and targeted images.

The studies were carried out with the patient in an upright position, facing the X-ray tube. When taking photographs in direct projection, the height of the digital detector was adjusted so that the lower edge of the detector was located at the level of the lower transitional fold of the gland and tightly adjacent to the chest wall. The mammary gland was pulled forward and placed on the receiver in such a way as to avoid the formation of folds; the nipple was brought out onto the contour. Then the gland was compressed with a special transparent plate and an image was taken. The X-ray beam passes from top to bottom through the center of the breast. With the correct placement of the gland in a direct projection, the image of the entire mammary gland in the lateral and medial retro mammary adipose tissue and the shadow of the pectoralis major muscle along the edge of the mammogram are determined.

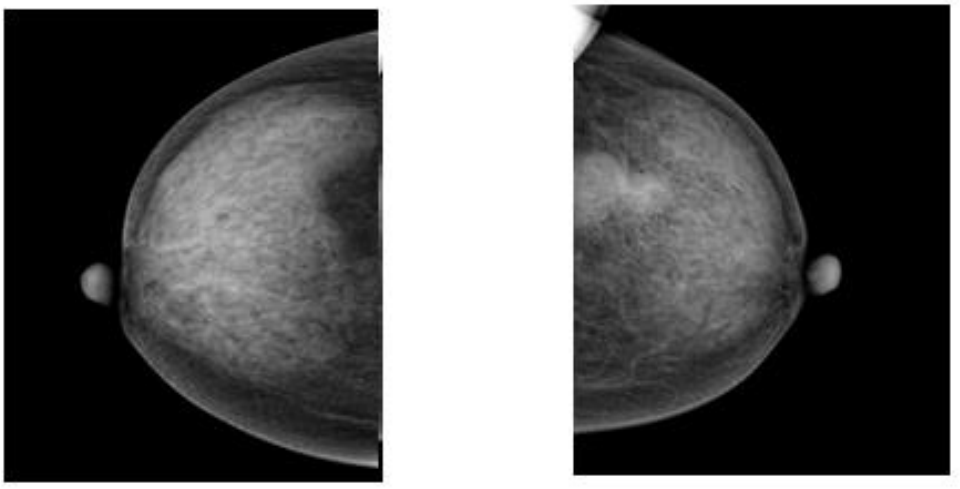
More informative is the oblique latera -medial projection. This image better shows the retro mammary space, axillary region and superior outer quadrant. When the examination is performed correctly, all breast tissue and the axillary region are visible; the inframammary fold is straightened and located lower. The nipple is outlined. The main criterion for correct placement is the visualization of the pectoralis major muscle along the sidewall of the image from the level of the nipple.

First, the radiographic density of the mammary glands was assessed using the BI-RADS system (Breast Imaging Reporting and Data System, System for describing and processing data from radiation studies of the breast) 5th revision, proposed by the American College of Radiologists in 2013, according to which the density of glands is divided into 4 categories: A, B, C, D. (Table 1)

Table 1.ACR Classification, BI-RADS 5th Revision, Breast Tissue Density Categories

Category	Characteristic
Category A.	adipose tissue predominates, sensitivity of the method (mammography) high;
Category B.	scattered areas of high-density fibro glandular tissue are determined;
Category C.	glands of heterogeneous density, small volumetric formations can be masked by dense fibrous tissue;
Category D.	The glands are very dense; the sensitivity of the method is low.

To perform the study, the woman turned around to face the mammography, the X-ray tube and digital detector were tilted at an angle of 45˚, perpendicular to the pectoralis major muscle. The gland was stretched and compressed so that the nipple was placed on the contour and an image was taken. The beam passes from the lateral superior point to the inferior medial.
After determining the density of mammary gland tissue, the presence of nodular formations, their location, size, shape, structure and contours were assessed. The presence or absence of calcifications, their prevalence, size and shape, and the degree of suspicion regarding malignancy were determined. Areas of asymmetry and structural restructuring were identified. According to the totality of all identified data, all detected changes belonged to one of the categories of the BI-RADS 5th revision system developed by the American College of Radiologists.
Two sets of images are evaluated: a low-energy image corresponding to traditional X-ray digital mammography and a subtraction image obtained by subtracting a high-energy image from a low-energy one (Fig. 1).



A B

Fig.1. Dual-energy contrast spectral mammography (CESM) images. A – low-energy image, right breast, CC. Severe fibrocystic mastopathy with a predominance of the glandular component (category D), nodular formations are not detected. B - low-energy image, left breast, CC. Dense glandular background (category D); two adjacent tumor nodes with heavy outlines are identified in the upper outer quadrant.

DISCUSSION OF THE RESULTS OBTAINED

Interpretation of the results obtained during X-ray mammography is carried out according to the BI-RADS 5th revision system.

The identified changes, based on the totality of their characteristics, belong to one of the categories of the BI-RADS system from 0 to 6. Category 0 is established for screening examinations and requires additional diagnostic methods. Categories 1 and 2 correspond to normal or benign changes do not require additional interventions, and a routine examination is prescribed. Category 3 speaks in favor of benignity and requires the appointment of dynamic monitoring after 3 or 6 months. Categories 4 and 5 require mandatory intervention to confirm the diagnosis morphologically. Category 6 means histologically confirmed breast cancer, the patient is subsequently referred to an oncologist to determine treatment tactics. This classification promotes continuity between radiologists at various diagnostic centers and hospitals, unifying the algorithm for examination and further management of patients with changes in the mammary glands. The obtained data are assessed according to the ACR BIRADS MRI 2013 classification presented in Table 2.

Table 2. ACR BI-RADS MRI classification

Category	Definition	Probability of malignancy	Recommendations
BI-RADS 0	The examination is not completed	-	Survey
BI-RADS 1	Norm	0%	Conventional MRI screening
BI-RADS 2	Benign formation	0%	Conventional MRI screening
BI-RADS 3	Probably benign	<0 but ≤2%	Follow-up after 6 months
BI-RADS 4	Lesion suspicious for malignancy	2-95%	Biopsy
BI-RADS 5	Highly suspicious for malignancy	≥95%	Biopsy
BI-RADS 6	Confirmed malignant process	-	Surgery

False results occur in different age groups, but are more common in young women with a dense background. This is explained by the fact that, with a dense surrounding background, small formations and areas of structural restructuring may be invisible. It is believed that about 20-30% of malignant breast formations remain undetected according to traditional mammography [10]. The situation can develop in the opposite way, when compacted areas of tissue are mistaken for false formations, which occurs in 11-22% of cases and is the reason for prescribing unreasonable repeated examinations, invasive interventions, and, consequently, leads to severe psychological trauma to the patient, which the woman may experience do not come to the next study [11].

Undoubtedly, one big advantage of digital X-ray mammography is the possibility of creating on its basis two methods for examining the mammary glands, which are becoming widespread throughout the world - digital tom synthesis and contrast-enhanced mammography (CESM).

Despite the relatively high efficiency of the method, digital X-ray mammography has a number of disadvantages, such as radiation exposure, low sensitivity in dense breast tissue, and a high rate of false positive and false-negative responses.

CONCLUSIONS

According to the data obtained from a study of patients with breast cancer, false results occur, as the examinations show, in different age groups, but are more common in young women with a dense background. This is explained by the fact that, with a dense surrounding background, small formations and areas of structural restructuring may be invisible. It is believed that about 20-30% of malignant breast formations remain undetected according to traditional mammography [10]. The situation can develop in the opposite way, when compacted areas of tissue are mistaken for false formations, which occurs in 11-22% of cases and is the reason for prescribing unreasonable repeated examinations, invasive interventions, and, consequently, leads to severe psychological trauma to the patient, which the woman may experience do not come to the next study [11].

Undoubtedly, one big advantage of digital X-ray mammography is the possibility of creating on its basis two methods for examining the mammary glands, which are becoming widespread throughout the world - digital tom synthesis and contrast-enhanced mammography (CESM). The assessment was carried out according to a standardized research protocol developed by us.

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