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Review article ■

What Does BIRADS Provide in Mammography?

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SUMMARY

It is not enough just to do mammography, but perform a quality one. American Association of Radiologists (American College of Radiology - ACR) introduced a unique and a standard terminology in radiological diagnosis of breast disease calling it the Breast Imaging Reporting and Data System or abbreviated BIRADS.

The aim of the paper is to present a modified version of BIRADS classification provided by the American College of Radiology as a standard glossary of radiological terms in the radiological diagnosis of breast disease. The paper material consists of the literature reports and more than 30.000 mammographies performed in the period 1995-2009 in the Radiology Center (former Institute of Radiology) of Clinical Center in Niš. The answer to the question about standardization of terminology is given in the diagnosis of diseases of the breast imaging. BIRADS is shown as a standard glossary of terminology provided by the American College of Radiology. BIRADS is encoded conclusion of breast disease. BIRADS is the standard model of terminology in the imaging diagnosis of breast disease. In the Republic of Serbia, BIRADS is in use in many diagnostic institutions.

Key words: **mammography, breast, tumor, BIRADS**

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INTRODUCTION

Mammography is a simple, noninvasive radiological method and it is used to examine breast (1-10). The structure, shape and consistency of breast require the use of specially constructed X-ray machines called mammography, which is characterized by a special x-ray tube structure, which emits the x-rays of low energy - about 20 kV (1).

The principle of mammographic diagnosis is based on the degree of x-ray absorption by the fat, fibroglandural and cancerous tissue, which listed by this order have a greater and greater absorption power of x-rays (1, 3, 8, 9, 10). Fat in the inviolate breasts helps with the picturing of lesions, so that relatively "small nodules" can be visualized. Youthful breast with plenty of fibroglandural tissue and low in fat gives the lowest contrast, and radiological diagnosis is difficult.

Mammography should be done in the first 10 days of the menstrual period when breasts are less painful and sensitive to pressure, which is inevitable in mammograms (4, 9, 10).

The basic criteria for quality mammography examinations are: quality mammography, proper positioning of the breast, technically well-performed examinations, high-quality mammograms, well-dressed technologists, radiologist's knowledge and more (1, 2, 6, 10-13).

Standard screening projections of breast are cranial caudal (marked as CC on mammograms) and medial lateral or oblique projection (ML) under the angle ranging from 30° to 45°. At least, two mammograms should be performed for each breast, one in the CC and the other in the ML projection. Also, it is possible to do mammograms in additional projections, if necessary (2, 9, 10, 14).

Additional mammographic views are: lateral projection, lateral exposure of the cranial caudal projection, projection of inter-mammary groove, caudal cranial projection, projection of the breast rotation, later medial oblique projection, superolateral-inferomedial oblique projection, projection of Cleopatra position, tangential projection, compression to the target areas of interest, image magnification of the area of interest. Additional mammographic screenings include mammography of male and implant breasts (2, 10, 14).

The radiological technologist performs taking and developing of mammograms and doctor-radiologist, with at least five years of work experience, explains the obtained mammograms. Mammography findings should be saved properly for future mammography screening, for comparison with new mammograms.

Thus, it is easier to observe the changes made during the period between two mammograms or to follow the changes that were noticed in previous mammograms.

The purpose of mammography is to detect changes that might be malicious. According to the National Cancer Institute, USA breast cancer incidence by age is 1:2500 in women aged 20 years, 1:63 in women aged 40 years and 1:28 in women aged 50 years.

Glossary of breast disease terms in imaging diagnosis should be standardized, because radiologists differently describe the visualized changes on mammograms (depending on the type of change), and in mammographic findings one may find the terms such as soft tissue, dense or intense shadow, micro calcifications, macro calcifications, thickening, disruption of architecture. We point out that every visualized mammographic shadow is not cancer. Many benign changes in mammograms are shown as a shadow (cyst, fibroadenoma, lipoma, etc.). For detailed evaluation, the mammographic examinations are supplemented by ultrasound, magnetic resonance (MRI) mammography, or if necessary, any other examination technique (1, 2, 4, 7-10). The doctor - radiologist decides to perform additional diagnostic examinations on the basis of analyzed mammograms.

History of mammography

Mammography, as a new radiological method of examination, dates from 1913. Dr. Albert Solomon, from the University Surgical Clinic in Berlin, compared radiographic with pathological findings in about 3.000 samples of mastectomy. Working with breast tissue that had been removed due to large cyst (4, 5), Solomon noticed in its X-ray image the punctiform calcifications (one of the pathognomonic signs for the malignant process in breast cancer).

Stafford Warren (Strong Memorial Hospital, Rochester, NY, USA) published one of the first articles about clinical use of mammography. The problems that occurred during the mammographic examination (high voltage, low amperage, bad mammograms, problems of interpretation of mammograms, etc.) made them proceed with further detailed research.

In 1960, the radiologist RL Egan from the Texas University (USA) introduced mammography with low voltage, high amperage, and the use of x-ray film with fine industrial grain emulsion which had very high resolution. Egan's work was followed and positively rated by 24 medical centers: University of Texas MD (February 1965), Anderson Hospital and Tumor Institute, Houston and Cancer Control Program of the US Public Health Service wherein in a sample of 475 malignant tumors diagnosed by biopsy, mammography found 376 positive samples (79%), and in a sample of 108.1 cases with benign lesions, mammography diagnosed 999 (10%) samples to be false positive. Based on these results, Public Health Service establishes six mammography centers: University of Texas, Emory University School of Medicine in Atlanta; Community Hospital in Glen Cove, Long Island; Mason Clinic, Seattle, Woman's Hospital in Detroit, University of California - Medical Center, San Francisco.

Imaging diagnosis of breast

Native mammography is in our everyday routine use. It is performed without the use of contrast media. It is estimated that its diagnostic accuracy is valid in 85-90% of examinations, and in 6-10% false negative (2, 6, 9).

A distinction should be made between clinical mammography (effective in diagnosing unclear clinical findings in symptomatic patients) and screening mammography (during which a selection of asymptomatic patients is performed) (11-14).

Galactography is contrast mammography during which a small amount of hydrosolubil iodinated contrast media is injected into the milk duct (1, 2, 10, 15). Indication: abnormal nipple discharge and others.

MRI mammography (MRIM) uses the technique of magnetic resonance (1, 15). According to the literal data, its diagnostic accuracy is 98% for invasive changes in diameter over 4 mm. Pose of the patient: lying on her stomach on a specially constructed bed. Before and after injection of paramagnetic contrast media - Gd-DTPA (15,16) 30-50 intersection are made. Indication: differential diagnosis of recurrence, scar changes, multifocal or bilateral changes, estimation of preoperative results in the neoadjuvant use of chemotherapy or radiation, negative findings in mammography, positive biopsy of axillary lymph nodes, breast implants, where the native mammography is useless and others. We point out that the MRIM is not a screening method.

Scintimammography is a nuclear medicine examination method. This method involves the use of radioactive substance (methoxy - isobutyl - MIBI isonitril with technetium - 99m). The principle of diagnosis: tumor cells attach Tc-99m-MIBI with a large percentage. The application of this method is limited to very small breast tumors. According to the literature data, diagnostic precision ranges from 80-96%, while its specificity is 84-100% (1). Indication: young women with very dense gland parenchyma, where the finding of native mammography is negative.

Digital mammography uses a computer image, obtained after the conversion of analog X-ray images into digital pictures. This method allows detailed analysis of mammograms, which can also be increased or decreased, shown in the positive or negative projections; radiologist can change the contrast of the image, crop it or compare with earlier findings.

Breast ultrasound is a technique of breast tissue examination using high frequency sound waves (17,18). Some ultrasonographists think that the high-resolution ultrasound (sonde of 10 - 13 MHz) will become the right and first choice in detection of invasive breast cancer. This examination method is invaluable in detection of palpable nodes in the breast and in differential diagnosis between solid and cystic changes. Ultrasound is also useful in helping physicians guide a biopsy or aspiration to obtain new and often predictive fact. Indication: young women with mastopathy, women with post-operative scars or with scars after therapy or radiation, breast implants, breast after hormone therapy.

Color-Doppler sonography represents an ultrasound technique of breast examination that allows the visualization of abnormal vascularity in solid formations of breast.

Radiological methods of breast examination include interventional radiological methods - stereotactic biopsy, ultrasonographic guidance for cytological puncture, biopsy using MR. Radiofrequency ablation of breast cancer-burning of the tumor with electrode using ultrasound guidance (currently in use for small nodes under the skin of the breast) is of relevant importance.

These methods of breast examination are compatible and each of them has its place in diagnosis of breast disease (1, 2, 6, 10, 17-21).

Nowadays, mammography and ultrasound of the breasts are much more in use as methods and become complementary methods for breast examinations.

In the Republic of Serbia, mammography diagnostics of pathological conditions and breast diseases is determined by law regulations. Diagnostic mammography is in use. Screening-mammography is obligatory by the government decision for high risk groups.

In 2006/2007, Croatia implemented the organized screening mammography named “Mama" (20).

In Serbia, in 2009, the screening mammography "Serbia against cancer" was organized in which the Center of Radiology, Clinical Center Niš also participated.

BIRADS terminology in diagnosis of breast disease

It is not enough just to do mammography, but perform a quality one. To realize it, the American Association of Radiologists (American College of Radiology - ACR) has introduced a unique and standard terminology in radiological diagnosis of breast disease by calling it **B**reast **I**maging **R**eporting and **D**ata **S**ystem, shortly **BIRADS** (4, 5, 14, 21-29).

In 2003, American Association of Radiologists published the fourth revised BIRADS classification providing unique and standarized breast imaging terminology (26).

Health services of many European countries use different glossaries and terms for radiological diagnosis of breast disease. BIRADS attempts to unify and standardize the glossary of radiological diagnosis of breast diseases for European countries and beyond. Among other mentioned, BIRADS showed great functionality in health systems outside the USA, primarily in Europe and Asia (4, 5, 14, 20, 22).

The aim of this paper is to present a modified version of BIRADS classification as a standard glossary

of radiological terms used in radiological diagnosis of breast disease.

The material consists of literature reports and more than 30.000 analog mammographies performed from 1995-2009 in the Radiology Center (formerly Institute of Radiology), Clinical Center Niš.

What does BIRADS provide?

BIRADS was created by the American Association of Radiologists as a standard for mammography reporting and interpretation of mammographic breast images. It sets up a classification criteria for the Level of Suspicion (LOS) - the possibility of breast cancer.

BIRADS gives names for the changes that are visualized in mammograms, the criteria for analyzing these changes, terms of the criteria by which these changes in the breasts are analyzed, content of radiological findings, conclusions to define radiological findings, which were numerically identified and classified on the basis of risk that qualified the observed change as malign, and if necessary, biopsy should be performed.

In relation to the initial form, BIRADS is constantly checked, supplemented and modified, as the terms of the initial mammography were adapted for ultrasound examination of breast (ECHO) and MRI mammography (26-29).

BIRADS is convenient for computer processing of the findings within the hospital information system (3, 4).

The fourth edition of BIRADS contains a glossary of common terms for the radiological diagnosis of breast diseases, ranging from BIRADS 0 to BIRADS 6, where BIRADS 4 is subdivided into BIRADS 4a, 4b and 4c (Table 1).

Table 1. *BIRADS classification criteria for Level of Suspicion of breast cancer*

Category	Diagnosis	Criteria
0	Incomplete	Insufficiently defined mammography finding that requires additional review
1	Negative	Normal mammography findings
2	Benign	Mammography findings with benign changes
3	Probably benign	Mammography findings with probable benign change that requires radiological follow-up
4 4a 4b 4c	Suspicious abnormality Appears as: - Less suspicious - Medium suspicious - More suspicious	Visualized changes on mammograms are suspicious for malignancy and biopsy should be considered
5	Highly suspicious abnormality	Changes that are visualized on mammography represent a very high risk of malignancy and require surgical treatment
6	Biopsy-proven malignancy	Malignant change was histologically proven

Table 1 shows the BIRADS scoring system. The numbers in the left column are what appears in the conclusion of mammogram report.

The BIRADS categories for Level of Suspicion malignancy are:

- BIRADS 0 - insufficiently defined mammography finding that requires additional examinations (target mammography, mammography with magnification, ultrasonographic breast examination or comparison of new mammograms with previous mammography);
- BIRADS 1 - normal mammography finding;
- BIRADS 2 - mammography finding with benign changes;
- BIRADS 3 - mammography finding with probably benign change that requires initial short - term follow-up;

- BIRADS 4 - visualized changes on mammograms are suspicious for malignancy and biopsy should be considered. Depending on the risk of malignancy, this category is classified as: BIRADS 4a - less suspicious, BIRADS 4b - intermediate suspicious and BIRADS 4c - more suspicious;

- BIRADS 5 - changes that are visualized on mammography represent a very high risk of malignancy and require surgical treatment, and

- BIRADS 6 - biopsy proven malignancy.

In short, BIRADS represents the encoded conclusion of breast disease.

Nowadays, in Serbia, BIRADS is in use in bigger diagnostic centers, including the Center for Radiology of the Clinical Centre Niš. Donation of mobile mammography to our region, our institution (October 26, 2009, donation by the Royal Couple Karađorđević) represents a starting-point for the application and installation of BIRADS in Serbia.

The cardinal signs of mammography

The cardinal signs of mammography are divided into three levels: the shadow of the tumor, calcifications and other signs that can be seen on mammograms.

I Characteristic of tumor shadows seen on mammograms:

a) Shadow of the tumor appears as an irregular, oval, round, lobular or disturbed architecture with punctiform center.

b) The contour of tumor is covered with a shadow of the surrounding parenchyma, sharply delineated, not sharply outlined, microlobular or with spicules on the margin.

c) The intensity of tumor is as the intensity of half-shadow fat tissue, low-intensity soft-tissue shadow, and intense soft-tissue shadow or as shadow intensity of the surrounding breast parenchyma.

II Characteristic of calcifications visualized on mammograms

Calcifications appear as shadow that has an intensity of calcium, with pathognomonic formation and shape, number in $1cm^2$.

a) According to their distribution calcifications are grouped, linear (arranged in a line), segmental, regional, or diffuse.

b) By the number per $1cm^2$ area, calcifications can be less than 5 in the group, from 5 to 10 in the group of 10 or more in a group.

c) The form of calcifications appears as:

- Typically benign calcifications, such as cysts with milk of calcium, skin or dermal calcification, arterial calcification, lucent-centered calcifications, dystrophic calcification;

- Punctuate calcifications (usually measure less than 0.5 mm in diameter, look like pencils beat on the white paper);

- Intermedial calcifications, and

- Radiologically highly suspicious calcifications for malignancy, such as pleomorphic and branching calcifications.

III Other mammographic signs

Other mammographic signs include associated changes and specific changes.

a) Associated changes are localized close to the shadow of tumor or calcification, and they appear as skin or nipple retraction, skin thickening, intense shadow of Cooper's ligaments, shadows belonging to skin lesions and axillas, lymphadenopathy, disturbed architecture.

b) Specific changes include shadow of expanded ducts, shadow of intramammary lymph node, asymmetric breast tissue, focal parenchymal condensation etc.

What should contain a mammography finding?

According to the BIRADS, each mammography report should contain four sections (4, 5, 14, 26, 27).

The first part of mammography finding gives the information if it is a control or initial mammogram.

The second part of mammography finding describes the mammographic breast structure.

The third part of the mammography report describes pathological changes, if there are any, of course. If there is a tumor presence, then the tumor shadow (size, shape, contour, intensity, location), calcifications (form, distribution, location, size) associated changes and specific changes are described.

The fourth part of the mammography report is conclusion with BIRADS score 0-6, and if it is BIRADS 4 then it is denoted by 4a, 4b and 4c, depending on the abnormality level of suspicion.

CONCLUSION

We presented the fourth modified version of BIRADS classification of the American Association of Radiology from 2003, which is still in use. BIRADS classification represents the contemporary glossary of radiological methods for breast examination and encoded conclusion. BIRADS classification consolidates the terms of imaging diagnostics of the breast with a view to better quality of radiological diagnosis, and represents an accurate classifications of the radiological diagnosis of breast disease. BIRADS classification requires the analysis of morphological parameters that are visualized on mammograms, as it could be assessed with a score 0-6. Today, in the Republic of Serbia, BIRADS is in use in major diagnostic institutions, and among them is Radiology Center- Clinical Center Niš.

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ŠTA BIRADS PRUŽA U MAMOGRAFIJI?

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Sažetak

Nije dovoljno samo učiniti mamografiju, nego valja učiniti kvalitetnu mamografiju. Američko udruženje radiologa (American College of Radiology-ACR) uvelo je jedinstvenu i standardnu terminologiju u radiološkoj dijagnostici oboljenja dojki nazvavši je Breast Imaging and Reporting Data System ili skraćeno BIRADS. Cilj rada bio je da prikaže modifikovanu verziju BIRADS klasifikacije koju nam daje American College of Radiology kao standardni rečnik radiološke terminologije u radiološkoj dijagnostici oboljenja dojki. Materijal rada čine literalna saopštenja i preko 30.000 mamografija urađenih u periodu 1995-2009. godine u Radiološkom centru (nekad Institut za radiologiju) Kliničkog centra u Nišu. Dat je odgovor na pitanje standardizacije terminologije u imidžing dijagnostici oboljenja dojki. Prikazan je BIRADS kao standardni rečnik terminologije koji nam daje Američko udruženje radiologa. BIRADS predstavlja kodiran zaključak oboljenja dojki. BIRADS je standardni model terminologije u imidžing dijagnostici oboljenja dojki. U Republici Srbiji BIRADS je u primeni u većim dijagnostičkim ustanovama.

Ključne reči: **mamografija, dojka, tumor, BIRADS**