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MAMMOGRAPHIC PATTERNS DURING BREAST CANCER SCREENING IN WOMEN

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Abstract: INTRODUCTION: Breast cancer belongs to the malignant neoplasms that is positioned as the second most frequent cause of death worldwide in prevalence and mortality worldwide. Through mammographic screening, an attempt is made to reduce the statistics by applying them according to the risk in the woman, therefore the interpretation of the patterns in the mammography according to their malignancy is standardized by BI-RADS categories, being essential for the communication of the results between health professionals, which remains current and constantly updated.
GOAL: To describe the main mammographic patterns that are seen during breast cancer screening in women through the search of articles in scientific databases to facilitate correct interpretation by health personnel.
METHODOLOGY: It is a descriptive and retrospective analysis through a bibliographic review, based on 21 scientific articles obtained from certified online sites with academic content corresponding to the last five years with quartile 1 and 2 extracted from the database PUBMED, GOOGLE ACADEMIC AND COCHRANE, Sources WHO/PAHO officials and guides from Ecuador.
CONCLUSION: The use of BI-RADS as a tool provides like a dictionary the terms used to describe the findings during screening studies, harmonizing it with the different imaging modalities, be it mammography, ultrasound or magnetic resonance imaging, allowing effective communication between radiologists, health professionals. and patients.
Keywords: breast cancer, mammography, BI -RADS, screening, breast density

INTRODUCTION

Breast cancer is a type of cancer that originates in the cells of the breast tissue. It is the most common cancer among women, although it can also affect men, although to

a lesser extent. Breast cancer can develop in different parts of the breast, such as the ducts that carry milk to the nipple (ductal breast cancer) or the lobules, which produce milk (lobular breast cancer).[1]

Risk factors for breast cancer include a family history of the disease, inherited genetic mutations, older age, exposure to hormones, alcohol consumption, obesity, and lack of physical activity. However, it is worth noting that breast cancer can also affect people without apparent risk factors. Symptoms of breast cancer may include the presence of a lump or mass in the breast, changes in the size or shape of the breast, changes in the skin of the breast, nipple discharge or changes in the nipple, and redness or inflammation of the skin of the breast.[2]

The diagnosis of breast cancer is made through a combination of clinical examination, imaging tests (such as mammograms, ultrasounds, and MRIs), and biopsies to obtain samples of suspicious tissue for analysis in the laboratory. Breast cancer treatment varies depending on the stage of the cancer, the type of tumor, the presence of hormone receptors, and other factors. Common treatments include surgery (such as mastectomy or localized resection), radiation therapy, chemotherapy, hormonal therapy, and targeted therapy.[3]

According to statistics provided by the World Health Organization in 2020, breast cancer is one of the most dangerous types of tumors, being the second cause of death worldwide and one of the most frequent. In that year, 1,835,883 cases of breast cancer were recorded, representing 30.5% of all reported cancer cases. In addition, there were 2,261,419 new cases and 684,996 deaths, making breast cancer the highest cause of death among cancers affecting women.[4]

In the Ecuadorian context, according to data from the Ecuadorian Institute of Statistics and Censuses (INEC) from 2018, breast cancer accounted for 18.2% of all cancer cases in the country, with a total of 670 deaths, ranking as the eleventh cause of death among women. According to the GLOBOCAN database, in 2020 the prevalence of breast cancer in Ecuador increased to 43.3%, with an incidence of 2,475,082 new cases and 744,036 deaths.[5]

Research agrees on the importance of early diagnosis for timely treatment and thus reduce advanced cases with poor prognosis, which is why screening programs have been developed that consider who must be evaluated, how frequently and with which tests. Mammography is the first method used during screening due to its speed and simplicity to evaluate breast density that expresses the texture characteristics of breast tissue, making it possible to estimate and classify risk and adequately advise women.[6]

These joint density changes at the breast level are classified as mammographic patterns. The BI-RADS (Breast Imaging Reporting and Data System) categorization is currently used, which describes the discoveries in a standardized way, facilitating decision-making for treatment or follow-up during the screening. However, these values are subject to the interpretation of the radiologist who studies them, which can lead to diagnosing false positives as false negatives. Furthermore, the screening approach occurs from the first level of health care, so the adequate interpretation of these patterns by health personnel is important.[7]

With the above, the objective of this research is to assertively describe the patterns found during breast cancer screening that guide health personnel to detect at-risk patients in early stages and take appropriate follow-up measures for women at risk.

DEVELOPMENT

GENERAL ASPECTS OF THE MAMMARY GLAND

The mammary gland, also known as breast or breast, is a glandular structure present in the human chest, both in men and women. It is mainly composed of adipose tissue, glandular tissue and connective tissue. The mammary gland is located in the pectoral region, on the pectoralis major and minor muscles. Each breast is made up of glandular lobes, which in turn are divided into lobules. These lobules are the functional units of the mammary gland and are composed of milk-secreting cells.[8]

The lactiferous duct system is another important component of the mammary gland. These ducts are responsible for transporting the milk produced by the lobules to the nipple, from where it can be extracted during breastfeeding. The ducts branch and are distributed throughout the breast tissue. Adipose tissue is responsible for providing support and protection to the mammary gland. It also gives shape and volume to the breasts. In addition, the mammary gland is covered by a layer of skin that contains sebaceous glands and hair follicles.[9]

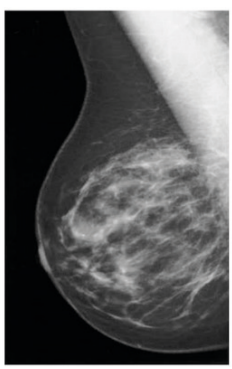

Figure 1-A. Mediolateral oblique projection of a normal breast.

Source. *Herring W. Basic Radiology Fundamental aspects [Internet]. 3rd ed. Maroto A, editor. Barcelona: Elseiver; 2016 [cited June 1, 2023]. 131-132 p.*

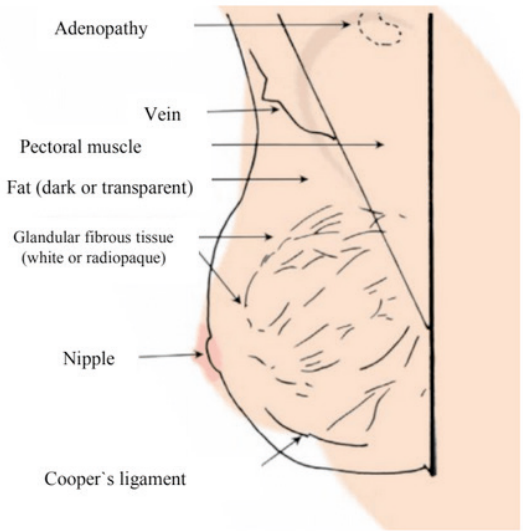

Figure 1-B. *Scheme of normal structures.*

Prepared by: Helen Apolo.

It contains the mammary glands, made up of structural and functional units called lobes that include epithelial and stromal components; The first, which connects them, is made up of the system of structural ducts which dilate and form the lactiferous sinuses (15 to 20), the stromal component surrounds the previous one and includes the breast volume composed of fibrous and adipose tissue.[10]

In addition, the breast tissue is separated and supported by fibrous bands or Cooper's ligaments and extend from the limit of the sternum to the axillary line between the second to sixth ribs. The blood supply is given by the internal mammary vessels while the lymphatic drainage is collected by the subareolar lymphatic plexus that connects with the pectoral, axillary and parasternal systems that connect with the subclavian lymphatic trunks that connect with the mediastinal and thoracic areas. and upper extremities.[11]

Risk factors for the development of breast cancer have been identified, which can be classified into two categories: modifiable, related to lifestyle and habits, and non-modifiable, associated with the biology of each

individual. Among these factors, advanced age and family history, both personal and family, are considered the main ones.[10-11]

Approximately 80% of breast cancer cases occur in women over 50 years of age, and 40% in women over 65 years of age. Additionally, having a family history of breast cancer increases the risk, and it is estimated that between 13% and 19% of women diagnosed with breast cancer have affected family members.[12]

Other risk factors include BRCA1 and BRCA2 gene mutations, being white, having an early or late onset of the menstrual cycle, experiencing menopause at a later age, having had no pregnancies or having had the first pregnancy after age 30. years, having received hormone replacement therapy, especially in the postmenopausal stage, having high alcohol consumption, smoking tobacco, taking certain medications, suffering from obesity, having been exposed to thoracic radiation and having dense breast tissue on mammograms.[11-12]

It is important to note that these risk factors do not guarantee the development of breast cancer, but an association has been observed between them and a higher risk of suffering from this disease. Each individual may have a unique combination of risk factors, and the presence of one or more of them does not necessarily imply the development of breast cancer, but may increase the likelihood of its occurrence.

All these characteristics and circumstances increase the possibility of developing cancer, so it is proposed to carry out the risk assessment for breast carcinoma during the consultation by the health professional and with the use of any model that will express the risk in percentage, in all women from 25 to 30 years of age which must be updated annually since a person's health information may differ from year to year.[13]

In the article "Screening for Breast Cancer: What You Need to Know" where a prospective study was carried out on 1,000 women, it indicates that the possibility of a woman contracting breast cancer can be average with a risk of 12% in those people without any risk factors, moderate risk of 15 to 20% in those who have modifiable risk factors, and high risk with a percentage greater than 20% in patients with a genetic or personal history of breast cancer.[14]

The clinical expression of breast carcinoma is characterized by breast pain followed by palpable mass and nipple discharge, especially bloody in women with breast cancer, and it can also present asymptomatically. Symptoms associated with cancer include depressions in the skin of the breast, erythema, edema, excoriations, blisters, contraction of the nipple, and skin changes (skin that looks like an orange peel).[10]

Although these symptoms are non-specific and may be present in other medical conditions, each of them is associated with a potential risk of malignancy, justifying the need for a complete diagnostic evaluation. This includes a detailed history and a thorough physical examination, in order to obtain a complete picture of the medical situation and determine those symptoms that may indicate a possible malignant etiology, which in turn will guide further diagnostic workup.[13]

The next step in the evaluation consists of the use of imaging tests, following a specific order that begins with mammography, followed by ultrasound, and in particular cases, magnetic resonance imaging may be considered. These tests allow more detailed information to be obtained and the characteristics of the suspicious lesion to be visualized.[12]

Diagnostic confirmation and staging of breast cancer are achieved by obtaining a tissue sample for analysis, through a biopsy. This biopsy is performed based on the suspicion

generated during the imaging study and physical examination, and provides definitive information about the presence of cancer cells and their nature.[14]

In summary, the diagnostic process for breast cancer involves the evaluation of symptoms, the use of imaging tests in progressive order, and diagnostic confirmation by biopsy of suspicious tissue. This makes it possible to determine the presence of cancer, as well as its stage or staging, which is essential for planning appropriate treatment.

BREAST CANCER SCREENING

Screening programs are implemented with the aim of detecting lesions suspicious for breast cancer in asymptomatic women in time, as a secondary prevention measure. These programs consist of performing diagnostic examinations on a regular basis, which allows early detection of patients and reduces the need for invasive treatments, which in turn improves prognoses.[12]

The decision of who must undergo these screening programs varies according to each country.

In the case of Ecuador, it is guided by the National Plan for Comprehensive Cancer Care, which is implemented at all levels of the National Health System. According to this strategy, it is recommended that healthy women between 50 and 69 years of age undergo screening for breast carcinoma through mammograms, performed every two years. However, in cases of women with a history of risk or symptoms, screening can be performed in advance.[13]

In the article "Breast Cancer Screening: An Evidence-Based Update" published by the Medical Clinics of North America, it explains that the age range is established because screening at ages under 50 years of age produces greater uptake in early stages, but expense of more false positives and healthcare resources, plus the every-two-year frequency results in fewer false positives.[14]

Deepa P. Budh, in her article; "Breast Cancer Screening", which reviews multiple randomized trials from different North American organizations against breast cancer, expresses that the decision to start screening with mammography is important since, depending on the age at which it is started or the frequency at which it is performed, it represents an increase in risk. radiation exposure. This causes an increase in the probability of radiation-induced breast cancer, with 125 cases per 100,000 women and deaths due to its detection.[6]

Regularization	Recommendations
USPSTF *U.S. Preventive Services Task Force*	Individually at 40–49 years Every 2 years at ages 50–74 It is not recommended for people over 75 years of age.
ACOG *American College of Obstetricians and Gynecologists*	It is proposed to start at age 40 every 1–2 years. In people over 75 years of age it is analyzed individually.
ACP *American College of Doctors*	Individually at 40–49 years Every 2 years at ages 50–74 Contraindicated in people over 75 years of age if they have comorbidities or life expectancy of less than 10 years.
ACS *American Cancer Society*	Start at 45 years old. Annually at ages 45 to 54 every 1–2 years in people over 55 years of age
NCCN *National Comprehensive Cancer Network*	≥ 40 years: annually

Table 1: Indications for breast cancer screening for individuals without risk factors

Source: *Budh DP, Sapra A. Breast Cancer Screening [Internet]. StatPearls. Treasure Island, editor. FL: Treasure Island; 2023.*

Mammography is considered the standard screening method for breast cancer. It consists of an X-ray modality that uses low doses (20 to 30 keV) to obtain a two-dimensional image. In this image, fibroglandular tissue appears radiopaque or white, while adipose

tissue appears radiolucent or dark. This allows identifying possible suspicious findings, such as masses, calcifications or deformed areas.[14]

The sensitivity of mammography is about 75%, meaning it can detect most cases of breast cancer. Its specificity is 91%, indicating its ability to correctly identify negative cases. However, breast density can affect these percentages, reducing sensitivity to 50% in cases of greater breast density, although specificity remains at 91%.[15]

Mammography can be used as a screening tool during screening, using two basic projections: the craniocaudal projection and the mediolateral oblique projection. It is also used as a diagnostic test in women with symptoms or with a lesion suspicious for cancer detected on mammography. In this case, additional projections can be performed according to medical criteria.[14]

MAMMOGRAPHIC PATTERNS

MAMMOGRAPHY INTERPRETATION SYSTEMS

Mammography findings must be recorded in reports that use assessment categories or patterns. Currently, the American College of Radiology's Breast Imaging Reporting and Data System (BIRADS) is used, with its fifth edition developed in 2013. These systems aim to establish a standardized visual or qualitative interpretation among radiologists, so that effectively communicate the results found, estimate the risk of malignancy and provide a recommendation for each identified category.[15]

The precursor was Wolfe who first proposed in 1976 a categorical classification based on four parenchymal patterns of breast density where N1 indicated a breast with parenchyma composed mainly of adipose tissue that has a low risk of breast carcinoma. DY represented the mammary gland with diffuse parenchyma or extensive nodular density and the highest risk of cancer.[4]

However, this categorization was considered simple taking into account that the radiological appearance of the breast varies by multiple factors such as age, body weight, genetic factors, among others.[4]

In 1992, the first edition of BI-RADS was introduced, which created the specific lexicon of image characteristics according to the description of their shapes or margins that gave probabilities of malignancy. This system was not intended to be maintained, but it was developed with subsequent publications in 1995, 1998, 2003 and 2013. Starting with the fourth edition (2003) it was adapted to be used in ultrasound and magnetic resonance imaging.[16]

Wei-guan and Qin-xiun in their retrospective study took 315 women with BI-RADS 4 or 5 lesions, for whom the radiomic score was calculated, a measure that reflects the texture and morphological characteristics of tumors on ultrasounds using a value Quantitatively, the use of the BI-RADS during this study helped demonstrate the discrimination performance of malignant and benign lesions in this new marker as in many other studies.[17]

The interpretation of the BI-RADS system is based on each mammographic pattern that is described under standardized terminology of the BI-RADS system's own lexicon and each one is associated with a level of suspicion of malignancy. Regarding the discovery of masses, it is described if their shape is oval, round and irregular, its margin can be considered circumscribed, darkened, micro-lobulated, blurred and spiculated as appropriate.[15,18]

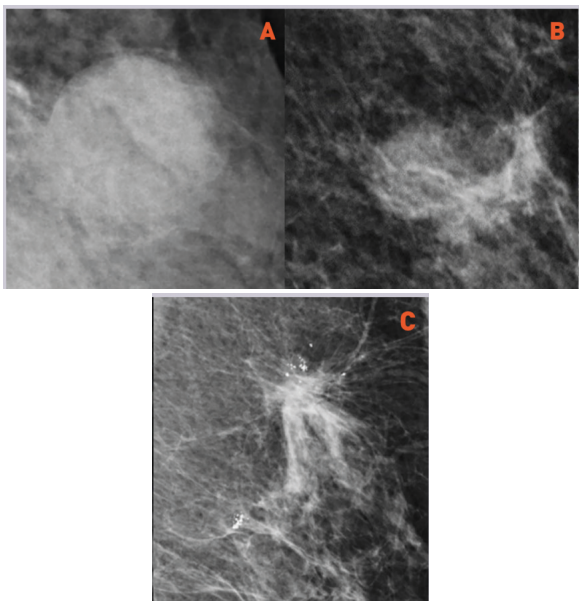

Figure 2: Magnified mammogram projections showing the shape of a mass. A: round. B: oval. C: irregular.

Source. *Camacho-Piedra C, Espíndola-Zarazúa V. Update of the BI-RADS nomenclature for mammography and ultrasound. Magazine: ``Anales de Radiología México`` [Internet]. January 29, 2019;17(2).*

Calcifications with benign morphology are expressed as cutaneous, vascular, thick or popcorn-like, round, border (encompasses eggshell), dystrophic, "calcium milk," and sutures. Calcifications with a suspicious appearance are described as having amorphous, thick heterogeneous, fine pleomorphic, and fine linear or fine linear branching appearance. Its distribution is also reported if it is diffuse, regional, grouped, linear and segmental.[15]

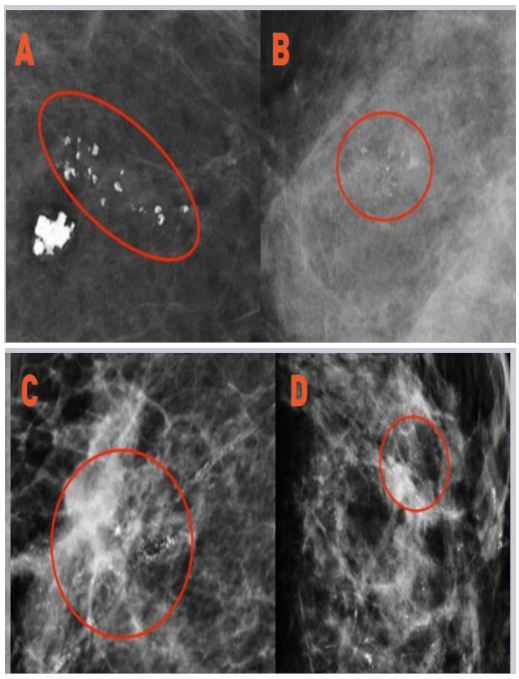

Figure 3: Magnified mammography projections showing calcifications with suspicious morphology (red circle), A: gross heterogeneous. B: amorphous. C: fine pleomorphic. D: fine linear or fine branched linear.

Source. *Camacho-Piedra C, Espíndola-Zarazúa V. Update of the BI-RADS nomenclature for mammography and ultrasound. Magazine: ``Anales de Radiología México`` [Internet];17(2).*

The description of asymmetries corresponding to radiopaque areas without defined borders that can be focal, global or developing, the latter being the most worrying. The finding of architectural distortion that may indicate malignant origin or as a result of benign scar tissue.[15,19]

Other findings on mammograms that are associated with breast cancer are described, such as skin or nipple retraction, intramammary lymph node, skin lesions, dilated solitary duct, skin thickening, and axillary lymphadenopathy. Common features found in breast cancer-related imaging findings include irregularly shaped and spiculated masses, pleomorphic

microcalcifications, anatomic distortion, and axillary lymphadenopathy.[10]

Breast density is another important variable to consider, since it is based on the amount of fibroglandular and adipose tissue present in the breast. Greater breast density indicates more fibroglandular tissue and less adipose tissue. Lesions with low density have a lower suspicion of malignancy, while high density is associated with a greater suspicion of malignancy.[4,19]

Breast density provides information about the detection ability of mammography and the probability of developing breast cancer. On the one hand, the presence of dense breast tissue can mask the detection of cancerous lesions on mammography, which increases the rate of false positives and can delay early detection of cancer.[4]

In the United States, reporting of breast density has become mandatory, because women with dense mammary glands may benefit from shorter screening intervals or depending on their mammographic density, a woman may choose to undergo another imaging modality, such as ultrasound or MRI according to medical discretion.[20]

Breast density assessment can be performed quantitatively using automated methods or qualitatively using the BI-RADS system, in which letters are assigned to categorize breast density. The letter "A" refers to completely fatty tissue, the letter "B" refers to scattered areas of fibroglandular density, the letter "C" indicates irregular density, and the letter "D" is used to describe excessive density. These categories allow radiologists to classify breast density and reflect concern about the masking effect of dense tissue, which could mask the presence of underlying cancer.[21]

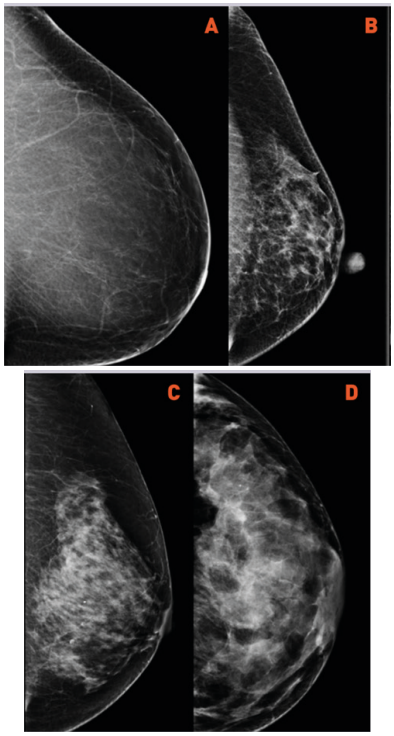

Figure 4: *Craniocaudal projections of mammography showing patterns of breast density. A: completely fatty, B: scattered areas of fibroglandular density, C: irregularly dense, D: excessively dense.*

Source. *Camacho-Piedra C, Espíndola-Zarazúa V. Update of the BI-RADS nomenclature for mammography and ultrasound. Magazine: ``Anales de Radiología México`` [Internet]. January 29, 2019;17(2).*

According to the study "BI-RADS BERT and Using Section Segmentation to Understand Radiology Reports", in which 900 radiology reports were analyzed, it stands out that reports play a fundamental role in communication between health professionals. These reports contain specific terminology related to each mammogram and are considered the primary form of communication in this field. Therefore, it is crucial that reports are presented in a structured manner, so that any doctor can correctly analyze the results of each patient and provide appropriate care.[22]

BI-RADS SYSTEM EVALUATION CATEGORIES

The article published in the American Journal of Roentgenology mentions that at the conclusion of the mammographic evaluation, the results are classified into seven categories or patterns from 0 to 6, and the prediction of benign or malignant diseases in the breast is made based on the final category. selected.[15,23]

An incomplete evaluation is represented by a BI-RADS score of 0, which is assigned to mammograms that have non-specific findings or that require additional studies using previous imaging for comparison, or using other methods such as ultrasound or MRI to obtain a diagnosis. definitive.[16]

BI-RADS category 1 indicates that no abnormalities have been detected in the results, indicating negative findings for malignancy. This may correspond to symmetrical breasts without the presence of masses, architectural distortion, or suspicious calcifications.[15]

The BI-RADS 2 category means benign findings, which is why it is also considered a negative mammogram. Here, scenarios such as benign-looking calcifications, a lipoma, the description of intramammary lymph nodes, vascular calcification, implants or distortion of the related architecture are manifested. to previous surgery. A BI-RADS category 3 indicates probably harmless changes with a less than 2% chance of carcinoma.[23]

The inclination towards malignancy increases in BI-RADS 4 where abnormalities suspicious for malignancy are treated. The risk of malignancy is very variable so it is subdivided into three, A, B, C, each with a percentage range for malignancy, low suspicion 2 to 10%, moderate suspicion 10 to 50%, high suspicion 50 to 50%. 95% respectively.[22,23]

BI-RADS category 5 indicates findings highly suggestive of malignancy with a percentage greater than 95% of being cancer; characteristics such as spiculated masses or pleomorphic calcifications with a malignant appearance may be present. Finally, BI-RADS 6 represents a biopsy-proven malignant lesion; it is used to describe malignant neoplasms confirmed before starting treatment.[16]

Category	Diagnostic impression	
BI-RADS 0	Unfinished study with need for additional imaging evaluation	
BI-RADS 1	Normal breast without findings	
BI-RADS 2	With benign results	
BI-RADS 3	With possibly benign results	
BI-RADS 4	Carcinoma suspect	4A - low possibility 4B - moderate possibility 4C - high possibility
BI-RADS 5	High suspicion of carcinoma	
BI-RADS 6	Confirmed malignancy	

Table 2: BI-RADS Categorization System

Source: *Pesce K, Orruma MB, Hadad C, Bermúdez Cano Y, Secco R, Cernadas A. BI-RADS Terminology for Mammography Reports: What Residents Need to Know. Radio Graphics [Internet]. marzo de 2019;39(2):319-20.*

The BI-RADS system also provides guidelines for the management of patients in each assessment category. For BI-RADS categories 1 and 2, where the mammogram is completely normal or a benign finding is found, continued routine screening at intervals of one to two years is recommended. If the benign finding is uncertain, an additional diagnostic mammogram is suggested.[11]

For category 3, follow-up with short-interval testing (6 months) for 24 to 36 months is recommended; If there are no changes during this period it is considered benign, the finding is reassigned to category 2. In category 4 and 5 a complete diagnosis of the tissue by biopsy is proposed, in case of discordance the biopsy can be repeated, while in results benign are followed up with mammography according to the previous category.[15]

On the other hand, if the biopsy is positive, the category would go to 6 where, according

to the histopathological characteristics of the definitive diagnosis, they will guide the therapeutic decision, which will be at the discretion of the responsible health professional.

Lee and Talati in their article "BI-RADS 3: Curten and Future Use of Probably Benign" mention that the BI-RADS 3 classification that designates a discovery as potentially innocent, falling in the middle of the others, is challenging to interpret since that maintain different meanings for mammography, ultrasound and magnetic resonance imaging, thus creating a wide possibility of actions for the responsible doctor. It can cause unnecessary concern in patients as it can be ignored by them and the doctor due to its low probability (2%) of malignancy.[15,19,24]

Many times it can be used for uncertain findings, delaying the diagnosis of a malignant lesion. The BI-RADS 3 monitoring protocol is the same in any imaging modality, which allows the finding to be recategorized correctly as long as short-term monitoring is adequately completed, which has demonstrated effectiveness in diagnosing almost 58% of malignant neoplasms. within this range and has reduced the number of unnecessary biopsies.[15,24]

BI-RADS presents several limitations during its use, such as the lack of development of the lexicon for the description of certain findings in the different imaging studies, especially with the development of technology, new modalities such as tomo-synthesis prevent the harmonization of terms, making it difficult to communication of results. Lack of clarification in categories as mentioned above with category 3 or in category 4 being subdivided can result in a reduction in the effectiveness of the interpretation.[24]

CONCLUSION

Early detection strategies for breast cancer are effective in reducing mortality associated with this highly prevalent disease and risk of death. The decision of when and how often to screen must be based on each person's individual risk. Although mammography remains the preferred method for screening, it is not a perfect test. It has limitations, such as radiation exposure, operator dependency, and two-dimensional representation of a three-dimensional structure.

However, mammography is the first step to diagnosis and its proper performance and interpretation by health professionals is of vital importance. BI-RADS mammographic patterns are necessary tools in radiological reports, since they allow the result of the mammographic study to be summarized concisely, facilitating communication and interpretation between radiologists and responsible doctors.

These patterns also help to make clear and appropriate decisions in the management of women with lesions suspicious for breast cancer. However, it is important to note that the BI-RADS system must not be applied strictly, as it attempts to simplify the findings of a disease that can present in a variety of ways.

Therefore, decisions based on these patterns must be individualized for each patient, taking into account all aspects of her clinical history. Furthermore, the suggestions provided in the BI-RADS system must not be followed rigorously since the categorization of this system attempts to simplify the findings of a pathology that presents in various ways, therefore, the decision made from these Patterns must be individualized in each patient taking all aspects of their clinical history.

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