BREAST ULTRASOUND: EVALUATION OF ECHOGRAPHIC CRITERIA FOR DIFFERENTIATION OF BREAST LESIONS*

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Abstract OBJECTIVE: Breast cancer is one of the most important causes of death in women. The association of different diagnostic methods has been successfully employed as a means to enhance early diagnosis. In this scenario, the interventional and diagnostic breast ultrasound has played a significant role. This study has two main objectives: to identify echographic criteria related to benignancy and malignancy and to analyze echographic characteristics, evaluating their role as malignancy predictors. MATERIALS AND METHODS: Echographic morphological criteria adopted in the images description were: shape, limits, contour, echogenicity, echotexture, echotransmission, lesion orientation, and secondary signs. Validation was sought on 450 echographic images compared with follow-up and histopathological results. RESULTS: Main benignancy criteria were: well defined shape, regular contour, precise limits, lesions isoechoic to fatty tissue, homogeneous echotexture, and horizontal orientation. The criteria more typically related to malignancy were: ill-defined shape, irregular contour, partially precise limits, and hypoechogenicity. Contour irregularity has presented the greatest sensitivity (92.7%) as well as the highest negative predictive value (98.2%), while vertical orientation of the lesion has presented the greatest specificity (99.3%), and ill-defined shape, the highest positive predictive value (91.0%). CONCLUSION: The standardization of the method for characterization and description of breast ultrasound images has resulted in reports uniformization and optimization, allowing more appropriate therapeutic decisions.

Keywords: Ultrasound; Breast lesions; Diagnosis.

Resumo *Ultra-sonografia mamária: avaliação dos critérios ecográficos na diferenciação das lesões mamárias.*
OBJETIVO: O câncer de mama é uma das causas mais importantes de mortalidade feminina. Na busca do diagnóstico cada vez mais precoce, a associação de métodos diagnósticos tem sido utilizada com êxito, tendo grande participação a ultra-sonografia mamária diagnóstica e intervencionista. Este trabalho tem como objetivos: identificar os critérios ecográficos mais relacionados com benignidade e malignidade e avaliar as propriedades das características ecográficas, verificando o seu poder de predição de malignidade. MATE-RIAIS E MÉTODOS: Os critérios morfológicos ecográficos utilizados nas descrições das imagens foram: forma, limites, contorno, ecogenicidade, ecotextura, ecotransmissão, orientação e sinais secundários. A validação foi buscada em 450 imagens ecográficas, comparadas aos resultados de seguimento ou de histopatologia de peça cirúrgica. RESULTADOS: Os principais critérios de benignidade foram: forma definida, contorno regular, limites precisos, lesões isoecóicas ao tecido adiposo, ecotextura homogênea e orientação horizontal. Os critérios mais característicos de malignidade foram: forma indefinida, contorno irregular, limites parcialmente precisos e lesões hipoecóicas. O contorno irregular apresentou a maior sensibilidade (92,7%) e o maior valor preditivo negativo (98,2%) para malignidade, a orientação vertical apresentou a maior especificidade (99,3%), e a forma indefinida, o maior valor preditivo positivo (91,0%). CONCLUSÃO: O método padronizado para a caracterização e descrição das imagens ultra-sonográficas mamárias apresentado resultou em uniformidade e otimização dos laudos, viabilizando as condutas mais adequadas.

Unitermos: Ultra-sonografia; Lesões mamárias; Diagnóstico.

INTRODUCTION

Breast cancer is one of the most important causes of death amongst women[1]. Mammography is the only diagnostic technique recognized for its proved contribution to the early detection and decrease in breast cancer mortality. However, the accuracy of this method is highly dependent on the breast parenchyma composition and tissular characteristics[1–4].

The association of diagnostic methods has been successfully employed in the search of a more and more early diagnosis of this pathological entity[1–4]. Breast ultrasound, both for diagnostic and interventional purposes, plays a significant role as a method supplementary to the clinical mammography, and has become a well established and invaluable method for diagnosis of breast diseases[1–4].

The first reference to breast ultrasound in the literature appears in 1951, with a study by Wild and Neal, describing *in vivo* sonographic features of two breast tumors, one malignant and another benign[5]. With

the introduction of the gray scale in the seventies by Kossof, Jellins et al. and, along the last decades, with the utilization of dynamic study, high-frequency linear transducers (7.5 MHz to 13 MHz) and electronic focus, the breast ultrasound has been established as a method for diagnostic evaluation in the mammary propedeutics[5].

This method is well tolerated and accepted by patients for not requiring ionizing radiation nor compression, besides being fast and easy to perform[1–4]. Additionally, today ultrasound is the only real-time imaging method widely available, representing an excellent modality for guidance of interventional invasive procedures, allowing the choice of the shortest route between the skin and the area of interest, with higher swiftness and minimum discomfort for the patient[6].

The echographic interpretation is based on the knowledge of the normal mammary structure, its variants and multiple aspects of breast diseases. Abnormal images have been evaluated and defined according to morphological characteristics. The capacity for evaluating morphological criteria of echographic images and differentiating between benign and malignant alterations has been subject for several studies, but there are controversies in the literature regarding the predictive capacity of each echographic characteristic[7–11].

Many authors consider that the combination of echographic criteria results in higher sensitivity and specificity of the findings when compared with the evaluation of an isolate characteristic[7,8]. For any isolate echographic characteristic to have practical applicability in the differentiation between malignant and benign lesions, this characteristic must be a finding with a high rate of interobserver agreement[7,8]. Considering that ultrasound is an operator-dependent method, the professional qualification, besides the operator experience, is clearly mandatory, allowing not only the images visualization, but also the utilization of morphological characteristics for differentiation between malignant and benign lesions[7–11]. A quantitative approach is suggested by other studies, aiming at analyzing tumors margins and texture on the basis of several mathematical techniques. These techniques have been employed as powerful ancillary diagnostic tools (computer aided diagnostics – CAD-type systems) for assessing different types of medical images, considering that quantification does not depend on the operator experience[12].

The standardization of terms employed for describing breast lesions is important since it allows a more objective analysis of images, creating an uniform nomenclature capable of indicating the degree of malignancy suspicion according to the morphology of the echographic findings and, consequently, allowing a more accurate orientation for the conduct to be adopted[13,14].

The present study aims at identifying those echographic criteria which are most closely related to lesions benignancy and malignancy, besides evaluating echographic characteristics to determine their predictive value for malignancy.

MATERIALS AND METHODS

Our casuistic included 637 cases of patients who had been referred by request of their doctors for undergoing ultrasound-guided fine needle aspiration (206 cases), and ultrasound-guided core-biopsy (431 cases), in the period between January and December of 2003.

All examinations were performed with a GE Logic MD 400 equipment with a multi frequency transducer, with orthogonal photographic recording of each image, besides appropriate material for each procedure. The photographic records review, as well as the evaluation for the presence of echographic criteria on images, was performed by one of the authors of the present study who has ten-year experience in breast imaginology and invasive procedures.

Of the 637 cases, 187 were excluded because the material was considered as unsatisfactory for the purposes of the present study. The remaining 450 cases are distributed as follows: 9 cases of simple cysts, 42 of complicated cysts, 2 of complex cysts and 397 cases of solid breast lesions.

This study was developed in a private service of diagnostic imaging to which the patients were referred by request of their doctors. It was up to the patients' doctors to make a decision about their treatment on the basis of information originated by the examinations (results of the invasive procedures), independently from the present study.

For the 450 selected cases, the standard test consisted of the histopathological results in the surgical cases (provided by the patients' doctors), and of the echographic follow-up of the lesions in later examinations performed during a six-to twenty-four-month period, in the non-surgical cases. Information on the follow-up was obtained in the service data-base or was provided by the patients´ doctors.

With the experience acquired through the daily practice, results from a previous study, and a literature review, we utilized the characteristics described by the majority of authors in this rating methodology as follows: the shape may be well-defined (rounded, oval-shaped, elongated) or ill-defined; limits may be precise (clear), imprecise (unclear) or partially precise. The contour or margins may be regular, partially regular (macrolobular aspect) or irregular (angular, microlobular, spiculated or indistinct aspect). The echogenicity is defined by comparison between images and the surrounding fibroadipous tissue, and may be anechoic, hypoechoic, isoechoic, hyperechoic and mixed (for example, anechoic and hypoechoic, or hypoechoic and hyperechoic). The echotexture is defined as homogeneous or heterogeneous. Echo transmission may be absent, present acoustic enhancement or posterior shadow. The orientation is defined as horizontal or vertical. Besides the aforementioned characteristics, the following secondary signs are taken into consideration: thickening and/or skin retraction; increase in echogenicity of the subcutaneous, peritumoral or parenchymal cellular tissues; thickening of Cooper ligaments; intratumoral calcifications; parenchymal architectural distortion; muscular and lymph nodes involvement (Figures 1–9).

In order to perform a binary evaluation of the properties of a diagnostic test, that is to say, sensitivity and specificity of morphological characteristic and their respective positive and negative predictive values, it was necessary to arrange certain characteristics into groups: Regular margins (regular and macrolobular); and irregular margins (indistinct, spiculated, an-
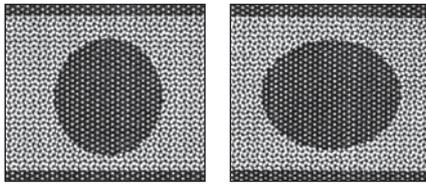
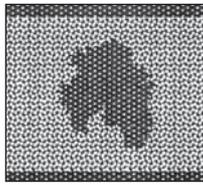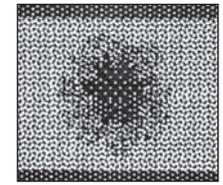**Figure 1.** Defined shape: round (**A**), oval-shaped (**B**).
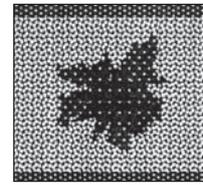
Figure 2. Ill-defined shape.
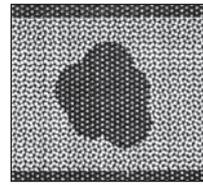
Figure 3. Limits: precise (**A**), partially precise (**B**) and imprecise (**C**).
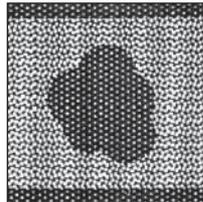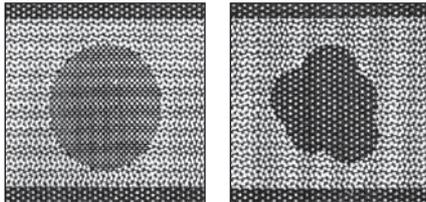

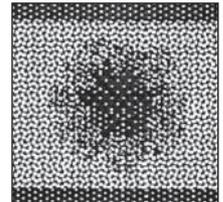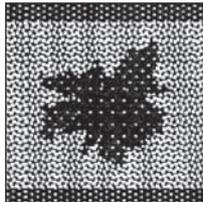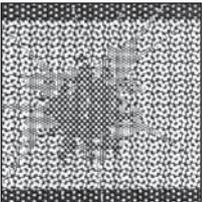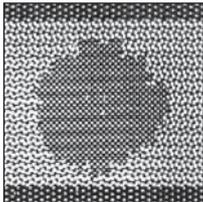**Figure 4.** Regular (**A**) and partially regular margins (**B**), also denominated macrolobular.

Figure 5. Margins: irregular, with microlobular (**A**), spiculated (**B**), angular (**C**), and indistinct aspect (**D**).
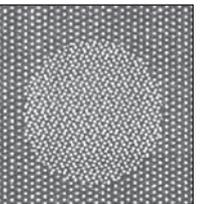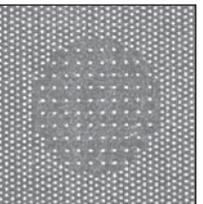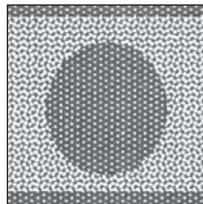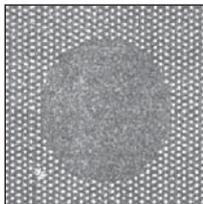

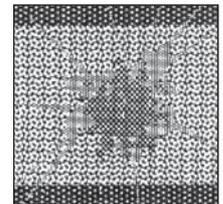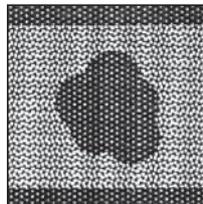**Figure 6.** Echogenicity: anechoic (**A**), hypoechoic (**B**), isoechoic (**C**), and hyperechoic (**D**).

Figure 7. Echotexture: homogeneous (**A**) and heterogeneous (**B**).
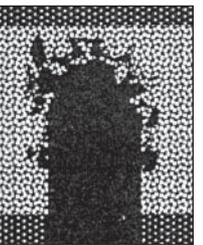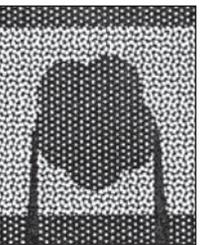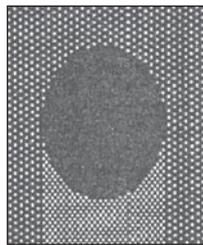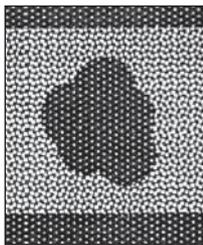
Figure 8. Echo transmission: absent (**A**), acoustic enhancement (**B**), bilateral acoustic shadowing (**C**) and central acoustic shadowing (**D**).
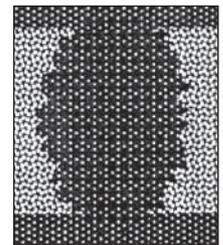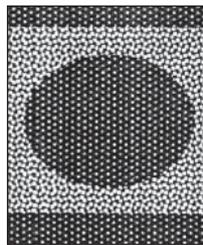
Figure 9. Orientation: horizontal (**A**) and vertical (**B**).

gular and microlobular). Images with partially precise and imprecise limits were grouped as lesions with imprecise limits. As regards echo transmission, the characteristics were grouped as present echo transmission in the presence of acoustic shadow or posterior enhancement, and absent echo transmission, in the absence of retrotumoral acoustic phenomenon. The software Epiinfo 6.04b CDC-USA, World Health Organization (Oct.1997) was employed for such evaluation.

The project was submitted to the Committee on Ethics in Research of Hospital Universitário Clementino Fraga Filho at Universidade Federal do Rio de Janeiro, and was approved with no restriction.

RESULTS

On ultrasound, the size of the 450 lesions ranged between 4 mm and 55 mm. In seven cases, the lesions could not be measured because of their large volumes.

The results of the procedures (fine-needle aspiration and core biopsy) were compared by means of the standard test (surgery and follow-up), resulting in 82 (18.2%) cases of cancer, and 368 (81.8%) cases of benign lesions.

The most frequent benign lesions were fibroadenomas (43.1%), followed by non-proliferative lesions (35.4%). Amongst the malignant findings, the infiltrating ductal carcinoma was prevalent, corresponding to 72.7% of cases (Figures 10A and 10B).
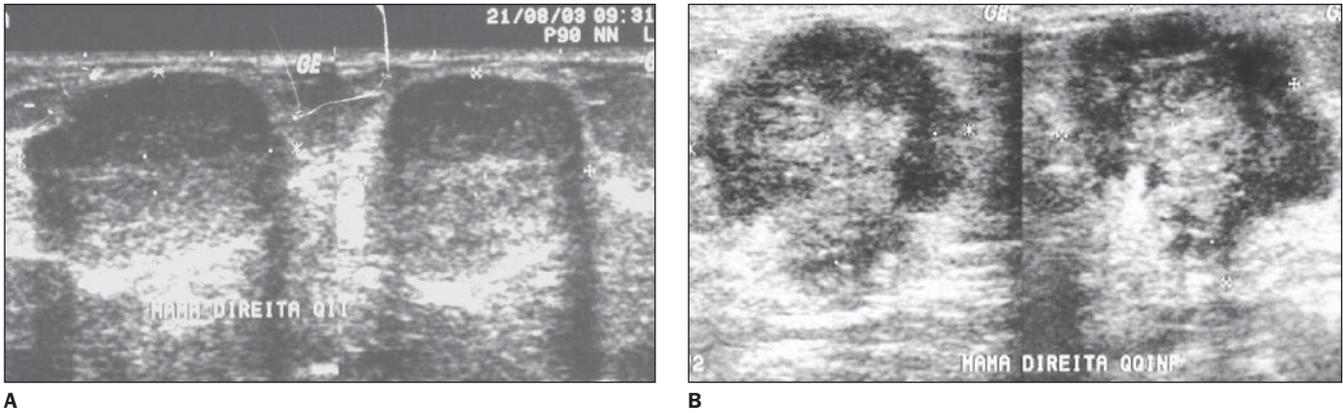
Figure 10. A: Hypoechoic, lobulated nodule, precise limits, homogeneous echotexture, horizontal orientation and bilateral acoustic shadowing (fibroadenoma). **B:** Hypoechoic nodule, microlobular and indistinct margins, partially precise limits, heterogeneous echotexture, vertical orientation (infiltrating ductal carcinoma).

In the studied casuistic, the patients' ages ranged between 16 and 88 years (mean age 52 years). Amongst patients who presented with carcinomas, the ages ranged between 29 and 88 years (mean age 60 years). On the other hand, the ages of patients with benign lesions ranged between 16 and 81 years (mean age 45 years).

A list of the breast lesions echographic characteristics is on Table 1, where the column "Benign" includes lesions in follow-up or those histopathologically diagnosed as benign, and the column "Malignant" includes those lesions considered as malignant at surgery.

Amongst the lesions presenting a defined shape, 94.5% (362/383) were benign, and amongst those with ill-defined shape, 91.0% (61/67) were malignant.

Amongst lesions with regular margins, 98.2% (336/342) were benign. Amongst lesions with irregular margins, 70.4% (76/108) were malignant, the microlobular type being the most frequently found — 30.5% of cases (33/108).

Amongst lesions with precise limits, 97.1% (338/348) were benign, and amongst those with imprecise limits, 70.6% (72/102) were malignant.

Amongst anechoic and hyperechoic images, 100% of lesions were benign. As regards hypoechoic images, 69.7% were benign, and 30.3% were malignant. Amongst isoechoic images, 98.7% were benign, and 1.3% malignant. Of those images presenting mixed echogenicity, 69.8% were benign, and 30.2% malignant.

Amongst the images with homogeneous echotexture, 91.3% (314/344) were benign,

and 49.0% (52/106) of those with heterogeneous echotexture were malignant, and 51% (54/106 were benign.

Echo transmission was absent in 72.4% (326/450), and the presence of acoustic enhancement or shadow was found in 27.6% of cases (124/450). Absent echo transmission was described in 83.7% (273/326) of benign cases; acoustic enhancement was reported in 95.5%, and posterior

acoustic shadow, in 66.2% of benign lesions.

Amongst images with horizontal orientation, 91.8% (348/379) were benign. Vertical orientation was present in 57.6% (34/59) of the malignant lesions. In 12 cases, images orientation could not be analyzed because lesion were on a deep plane and presented a marked acoustic shadow, complicating a correct evaluation of the lesion

Table 1 List of echographic characteristics of breast lesions and standard test.

Echographic characteristics	Malignant	Benign	Total
Ill-defined shape	61 (91%)	6 (0.9%)	67 (14.9%)
Defined shape	21 (0.5%)	362 (94.5%)	383 (85.1%)
Indistinct margin	13 (59.0%)	9 (41.0%)	22 (4.8%)
Spiculated margin	14 (66.6%)	7 (33.3%)	21 (4.7%)
Angular margin	16 (80%)	4 (20%)	20 (4.5%)
Microlobular margin	33 (73.4%)	12 (26.6%)	45 (10%)
Macrolobular margin	4 (2.7%)	142 (97.3%)	146 (32.5%)
Regular margin	2 (1%)	194 (99%)	196 (43.5%)
Imprecise limits	25 (71.4%)	10 (28.6%)	35 (7.8%)
Partially precise limits	47 (70.1%)	20 (29.9%)	67 (14.9%)
Precise limits	10 (2.8%)	338 (97.1%)	348 (77.3%)
Anechoic	0 (0%)	22 (100%)	22 (4.9%)
Hypoechoic	67 (30.3%)	154 (69.7%)	221 (49.1%)
Isoechoic/echogenic	2 (1.3%)	158 (98.7%)	160 (35.5%)
Hyperechoic	0 (0%)	4 (100%)	4 (0.9%)
Mixed	13 (30.2%)	30 (69.8%)	43 (9.5%)
Heterogeneous echotexture	52 (49%)	54 (51%)	106 (23.5%)
Homogeneous echotexture	30 (8.7%)	314 (91.3%)	344 (76.5%)
Absent echo transmission	53 (16.3%)	273 (83.7%)	326 (72.4%)
Acoustic enhancement	2 (4.5%)	42 (95.5%)	44 (9.8%)
Acoustic shadowing	27 (33.8%)	53 (66.2%)	80 (17.8%)
Vertical orientation	34 (57.6%)	25 (42.4%)	59 (13.1%)
Horizontal orientation	31 (8.2%)	348 (91.8%)	379 (84.2%)
Without evaluation	12 (100%)	0 (0%)	12 (2.7%)
Total	82	368	450

size, and, consequently, a precise evaluation of the lesion orientation.

Secondary signs were found just in 14 (17%) cases of malignancy, and were absent in 100% of benign cases.

The evaluation of characteristics more closely related to lesions malignancy was considered for analyzing the diagnostic properties, as per Table 2. The most sensitive characteristic was the irregular margins. Two characteristics presented a very high specificity: vertical orientation (99.3%) and ill-defined shape (98.4%). The negative predictive values were high, in contrast to the positive predictive values in the presence of echo-transmission (23.4%), and heterogeneous echotexture (49.1%).

DISCUSSION

The quality of a procedure is highly dependent on the operator's knowledge of the equipment, the appropriate technique, the results interpretation, the patient's history, besides the malignant, benign and functional alterations of the breast[2,4,15].

Notwithstanding all the studies reviewed have utilized high-resolution equipment and trained professionals, the divergences observed in the literature are due to different methodologies applied, either utilizing different morphological characteristics or different criteria for distinguishing malignant from benign lesions[7–9,16–19]. This diversity reflects the fact that not always all the morphological characteristics of an image with all their variables can be utilized[19].

Some features are unique to ultrasound, such as orientation and echogenicity, and some are fundamental to interpreting images, such us shape and margins[20].

Amongst the studies selected for the purpose of comparative analysis, all of them utilized the description of the contour or margin, followed by echo transmission,

echogenicity, echotexture and orientation. The features less utilized by the authors were: limits, compressibility, branching and size of the lesion[7–17,19,21–24].

Some authors[10,15,19,20,24,25] describe not only morphological signs of the lesions but also the alterations in surrounding tissues, the parenchyma architectural distortion being the most frequently described secondary sign.

An universal standardization of terms for description of echographic features is still pending, however, with the publication of the Illustrated Breast Imaging and Reporting Data System (BI-RADS®): Ultrasound by the American College of Radiology[26], most probably this standardization and consequent uniformization will be accepted.

Although studies involving interpretation and classification of sonographic images recommend an analysis of the concordance between observers, and limitation of the generalization based on studies by only one observer, Skaane and Engedal[17], Zonderland et al.[19], Buchberger et al.[27], and Chen et al.[28] have considered that studies interpreted by only one observer might be consistent in the application of criteria for a lesion definition.

The study developed by Chen et al.[28] suggests that sonographic characteristics considered in the lesions differentiation might vary in tumors, depending on their size. However, they consider that the most significant feature in lesions differentiation, independently from their size, is the contour or margins, according to the results reported by Skaane and Engedal[17].

Paulinelli et al.[9] evaluated the influence of the age and size of the tumor on the interpretation of the sonographic characteristics of solid breast nodules. These authors have concluded that the presence of irregular margins, internal heterogeneous echoes

and posterior shadowing in benign tumors is directly proportional to the patient's age. The presence of internal heterogeneous echoes, anterior halo and thickening of Cooper ligaments in malignant tumors is directly proportional to the size of the tumor.

Additional studies are necessary to reach a consensus on which echographic characteristics would be more significant, less subjective, and more reproducible, and, besides, it is necessary to analyze other factors which could affect the sonographic images interpretation and the risk of malignancy[9,11,14,20].

For most of the authors[16,17,19,21,22,25, 27–29], regular or macrolobular margins represented the main criterion for defining a lesion as benign. The shape described as defined, oval, rounded or ellipsoid was the second most important feature, in agreement with the results of the present study, where the regular and macrolobular margins were identified in 98.2% of the benign cases, and the defined shape, in 94.5%.

The malignancy characteristics most frequently described in the literature[9,10, 16–19,21,22,25,27–29] were irregular margins, presence of posterior acoustic shadowing, vertical orientation and irregular shape.

In the present study, the more characteristic signs of malignancy were: ill-defined shape, irregular margins, partially precise limits and hypoechoic lesions. Secondary signs were present in only 14 of 82 cases of malignancy, and absent in the 368 benign cases. The literature suggests a criterion for benignity in the absence of such signs[11,15,25,29], and a criterion for malignancy in their presence.[15,17,29]

In the 12 cases where orientation could not be identified due the size and localization of the lesion, the term "indeterminate" orientation might be employed, according to Zonderland et al.[19]. This pattern suggests a criterion for malignancy, since the 12 cases of indeterminate orientation had their malignancy confirmed on the surgical piece.

Main features considered by the several authors[11,15,16,22,24,25,27,29] as non-significant for lesions classification were: echotexture, echo transmission, when absent or in the presence of posterior acoustic enhancement, and echogenicity.

Table 2 Echographic characteristics properties suggestive malignancy.

Echographic characteristics	Sen. (%)	Spe. (%)	PPV (%)	NPV (%)
Ill-defined shape	74.4	98.4	91.0	94.5
Irregular margin	92.7	91.3	70.4	98.2
Imprecise limits	87.8	91.8	70.6	97.1
Heterogeneous echotexture	63.4	85.3	49.1	91.3
Present echo transmission	35.4	74.2	23.4	83.7
Vertical orientation	52.3	99.3	57.6	91.8

Sen., sensitivity; Spe., specificity; PPV, positive predictive value; NPV, negative predictive value.

In the present study, the criteria non-significant for echographic differentiation were: echotexture and echo transmission. Amongst 106 images with heterogeneous echotexture, 52 cases (49%) were malignant and 54 cases (51%) were benign. As regards posterior acoustic findings, acoustic shadowing was present in 66.2% of the benign lesions and in 33.8% of the malignant lesions, in contrast to other authors observations[7,10,11,17,19,21–24,27–29].

A contradiction is observed in the literature. While the features most utilized by the authors for echographically describing a lesion were echo transmission, echogenicity and echotexture, such features were not significant for differentiating a malignant from a benign lesion.

The definition of the echotexture of a lesion as homogeneous or heterogeneous depends on the diversity of the tissues in such lesion. For example, a lesion might be heterogeneous for presenting areas of necrosis (carcinomas) or due to fibroadenomas (benign) hyalinization[28]. So, the utilization of this single characteristic might lead to misinterpretation. The absence of a prognostic value of this variable was described by Stavros et al.[11] and Skaane and Engedal[17]. Also, it is important to note that in the new standardization of the American College of Radiology[26], this feature was not taken into consideration.

Echogenicity might be defined as a shade of the gray scale demonstrating a lesion and representing one of the main problems in the description of such lesion[21,24]. In the absence of standardization, the echogenicity becomes a source of subjectivity, since the gray scale parameters utilized for this type of characterization are still to be known.

In the study developed by Stavros et al.[11], the lesions echogenicity was compared with the normal adjacent adipous tissue, i.e., with a structure of echogenicity approximating the gray scale spectrum, that was uniform and present in all of the patients. For Stavros et al.[11], the hyper-echogenicity of a lesion represented the feature with higher negative predictive value (100%). In a different way, Soon et al.[24] have compared the lesions echogenicity with the adjacent glandular tissue in 393 cases of carcinoma, and have found two cases (0.5%) of carcinomas as hyper-echoic lesions. For Zonderland et al.[19], the gain adjustment in the equipment, as well as the breast thickness, might affect the echogenicity description.

In the study developed by Chen et al.[28], echogenicity was the main feature in the differentiation between infiltrating carcinomas and carcinomas *in situ*, the latest presenting more isoechoic when compared with infiltrating carcinomas.

The echo transmission is a function of the equipment, the transducer, the compression exerted during the procedure, the size, localization and even the type of the lesion[21].

The echo transmission has emerged in the beginnings of the breast ultrasonography as an essential, almost pathognomonic sign of malignancy, indispensable for diagnosis[5]. As a matter of fact, the experience has proved that this is a sign found in 20% to 60% of cases of breast cancer, especially in those where the tumor is larger than 2 cm[21]. This is the reason, mainly in cases of non-palpable tumors (with < 1 cm), for which the absence of echo transmission does not allow neither the exclusion of malignancy, nor assurance of benignity. An article published by Weinstein et al.[30], presents a group of benign lesions which might present posterior acoustic shadowing, like fibroadenomas, radiate scar, diabetic mastopathy, steatonecrosis, post-surgical scar, focal fibrosis, and sclerosing adenosis.

As regards diagnostic properties found by several authors and in the present study (Table 3), the irregular margins (microlobular, spiculated or angular aspect) and orientation were the echographic characteristics with highest rates of sensitivity, specificity and predictive values.

In summary, one may conclude that the main features for differentiating malignant from benign lesions are margins and shape of the lesion, with the first one presenting the highest sensitivity, and the second, the highest specificity.

Therefore, the quantitative study of the margins of a lesion might be a powerful tool for helping the observer to differentiate malignant tumors from the benign ones.

Alvarenga et al.[31], utilizing a method based on mathematical morphology for images segmentation, have found 95.7%

Table 3 Properties of malignancy echographic characteristics, by author.

Author	Echographic characteristic	Sen. (%)	Spe. (%)	PPV (%)	NPV (%)
Stavros et al.[11], 1995	Spiculated margin	—	99.4	91.8	—
	Vertical orientation	—	98.0	—	—
Blohmer et al.[25], 1997	Irregular margin	92.8	96.7	92.8	96.7
	Architectural alterations	88.7	96.7	92.5	94.9
Buchberger et al.[27], 1999	Microlobular margin	71.4	—	—	97.4
	Angular margin	—	99.4	—	—
	Ductal extent	—	—	100	—
	Vertical orientation	—	99.7	—	—
Calas et al., 2005 (this study)	Irregular margin	92.7	91.3	70.4	98.2
	Vertical orientation	52.3	99.3	57.6	91.8
	Ill-defined shape	74.4	98.4	98.4	94.5
	Imprecise limits	87.8	91.8	70.6	97.1

Sen., sensitivity; Spe., specificity; PPV, positive predictive value; NPV, negative predictive value.

sensitivity and 96.7% specificity in the differentiation of tumors by means of margins analysis.

The next step in this study will be to develop an interobserver study (with qualitative criteria), comparing it with the results obtained with quantitative methods applied to margins and echogenicity of lesions. Based on this comparison, we will be able to evaluate the contribution that the quantification may add to the final diagnosis of such lesions.

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