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Elastosonography in the Characterization of Breast Masses in Black Women in Lomé (Togo)

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Abstract: Objective: study the contribution of elastosonography in the characterization of breast masses. Methods: a prospective and descriptive study took place over a period of 6 months from February to July 2020 in the department of radiology of the Sylvanus Olympio teaching hospital in Lomé. Patients presenting a breast mass diagnosed by the conventional ultrasound were invited to take part in the study. Result: in total, fifty-four patients met our selection criteria, for an overall frequency of 2.9%. The average age of our patients was 24.2 years old with the 20-29 years age group being the most represented. The mean lesion size was 18.8mm with extremes of 5 and 35mm. The lesions classified as Birads 3 were the most prevalent (40.4%) and they all had an elasticity score of less than 3. 75% of the lesions classified as Birads 4 also had an elasticity score less than 3. All lesions classified as Birads 5 had an elasticity score greater than 4. We obtained a statistically significant relationship between the Birads classification and the elastographic score and also by differentiating the mammary masses into benign and malignant lesions by these two modalities. Conclusion: elastosonography is a diagnostic imaging method that allows rapid and easy evaluation of breast lesions and it provides a valuable addition to the ultrasound data in real-time. It provides complementary diagnostic information that could potentially assist in the characterization of breast lesions by B-mode ultrasound.

Keywords: Elastosonography, Breast Masses, Elasticity Score, Blacks, Togo

1. Introduction

Breast cancer is a real public health problem due to its frequency, severity and psycho-social implications. Indeed, it is the most common cancer among women in the world but also the most deadly [1, 2]. Its incidence is estimated at 24.5% or about one in four of new cancer cases diagnosed in women worldwide. It is estimated that 2,261,419 women are affected each year for 684,996 deaths in 2020 [1].

The incidence of breast cancer in Togo is particularly high (29.4%) [1]. In 2013, according to Darré et al. in Togo, the youngest patient suffering from breast cancer was 13 years old [3]. It is a particularly serious cancer, with a hospital prevalence of 21.2%, a mortality rate of 16.1% [4] and a 5-year survival rate of 20.7% in Togo [5].

Thus, face to this public health concern, any mass in the breast discovered fortuitously by the patient herself or during a clinical examination must be investigated and characterized.

There are several methods of medical imaging allowing the detection of breast masses, including ultrasound in two-dimensional mode (B mode). It is an essential complementary examination in the exploration of mammary masses, palpable or not, with a sensitivity of 98.4% but a low specificity (47.5%) [6, 7]. It makes it possible to obtain a morphological type of image of the tissues but unfortunately does not provide quantitative information on the mechanical properties of the tissues [8].

In order to improve the specificity of B-mode ultrasound, elastosonography, also called ultrasound elastography, has emerged. It is a new imaging modality discovered in 1991 by J. Ophir which allows to characterize the mechanical properties of tissues, in particular their hardness [9]. The elasticity of a tissue is its ability to return to its original state after being deformed. It can be modified by pathological processes in a diffuse or focal way as in the case of a tumor [8]. Benign tumors are known to be harder than the surrounding tissue and more elastic than malignant tumors.

Improving the characterization of mammary masses is essential for better diagnostic orientation of lesions and for limiting invasive procedures on benign lesions. Numerous studies have been carried out around the world to assess the contribution of elastography in the characterization of breast masses, but very few studies exist in blacks in Africa [10-13].

This work was initiated with the objective of studying the contribution of elastosonography in the characterization of breast masses in women.

2. Method

2.1. Framework and Method

This was a prospective and descriptive study carried out in the radiology department of the Sylvanus Olympio teaching hospital in Lomé from February to July 2020.

2.2. Study Population and Examination Technique

Female patients with a breast mass diagnosed by B-mode ultrasound during the study period were included in the study.

In order to meet the recommendations of the World Federation for Ultrasound in Medicine and Biology (WFUMB), patients whose lesion was very superficial (<3mm from the skin) or whose breast lesion was larger than the field of view of the probe were excluded from the study [14].

The examinations were carried out by a single operator to avoid inter-observer variation bias, on a single ultrasound device. The MINDRAY model DC 30 device, with strain elastography (static module) as well as color and pulsed Doppler options was used. The linear probe with a frequency varying from 7.5 - 10 MHz was used. First, each ultrasound lesion was evaluated in B mode. It was measured on all three axes and its largest measurement in millimeters (mm) was retained. Color Doppler ultrasound was used to study the vascularization of different lesions. Each mass was classified according to the BIRADS ultrasound classification of the ACR, taking into account the shape, the contours, the orientation, the echogenicity, the posterior acoustic features, and the orientation.

Then elastography was performed during the same ultrasound examination. The ultrasound probe was placed perpendicular to the skin plane opposite the lesion explored on a uniformly flattened breast. The acquisition was carried out by light manual compressions and repeated using the ultrasound probe. A deformation graph allowed to control the quality of the compression in real time. The ultrasound machine then displayed in real time a color elastogram of the chosen region of interest representing the deformation generated within this region. This color map allows the lesion to be classified according to the Tsukuba elasticity score [15].

2.3. Variables Studied

Demographic data: age, profession.

Clinical data: personal and family history (ATCD) of breast cancer, notion of taking oral contraception or hormone replacement therapy, menopause, breast pain, palpable mass, breast discharge, skin or nipple abnormality.

The ultrasound BIRADS classification: lesions with a category 2 and 3 Birads were considered as benign and those of categories 4 and 5 as malignant.

The elasticity score (Tsukuba score): lesions with a score of 1 to 3 are considered benign, while lesions with a score of 4 or 5 are considered to be malignant.

The ratio between the sizes of the lesion measured by elastography and by ultrasound in B mode, called "elastography to B-mode ratio" (E / B). A lesion with a ratio greater than 1 is considered likely malignant.

2.4. Data Analysis

The data collected has been recorded and processed by the software Sphinx plus2 V5, SPSS for windows version 10.0 (SPSS Inc., Chicago, IL), Microsoft office Excel 2013

The data were analyzed using the statistical chi-square test to study the correlation of the distribution of lesions according to the Birads class and the elastography score.

2.5. Ethical Matters

The investigation was approved by the head of the department and the Local Ethical committee at the hospital. All the participants were informed and their consent was obtained.

3. Results

3.1. Socio-demographic Aspects

During the study period, 1888 ultrasound examinations were performed, including 121 breast ultrasounds. The patients meeting the criteria were 54 patients, corresponding to an overall frequency of 2.9% and specific frequency of 44.6%. Four were excluded for mass larger than the field of view of the probe and / or too superficial. The 50 patients selected presented 91 breast masses (1.8 masse per woman).

The mean age of the patients was 24.2 ± 9.1 years with extremes of 16 years and 64 years. The 20 to 30 age group was the most represented with a frequency of 64% (n = 32).

3.2. Clinical Data

Palpable breast masses were the most common clinical symptom in 92% (n = 46). Women with a family history of breast cancer accounted for 4%.

3.3. Ultrasound Data

Among the 91 masses identified, 6 were cystic masses including 4 simple cysts, 1 complicated cyst, 1 complex cyst and 85 solid masses.

The mean lesion size was 18.8 mm with extremes of 5 and 35 mm. Lesions with a size between 10 and 19 mm were the most represented with a frequency of 49.4% (n = 45). The masses were predominantly located in the upper outer quadrant in 31.9% of cases (n = 29).

Lesions were classified as Birads 3 in 57.1% (n = 52).

3.4. Elastosonographic Data

Lesions with an elasticity score of 2 accounted for 52.7% (n = 48) (Figure 1).

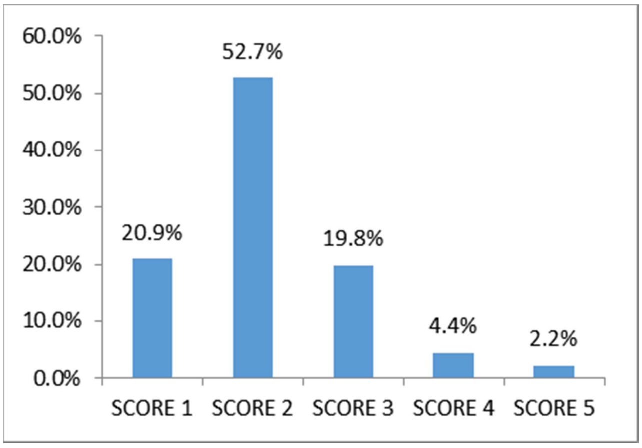

Figure 1. *Distribution of patients according to the elasticity score.*

The Figure 2 presents some examples of breast lesions with their elasticity score.

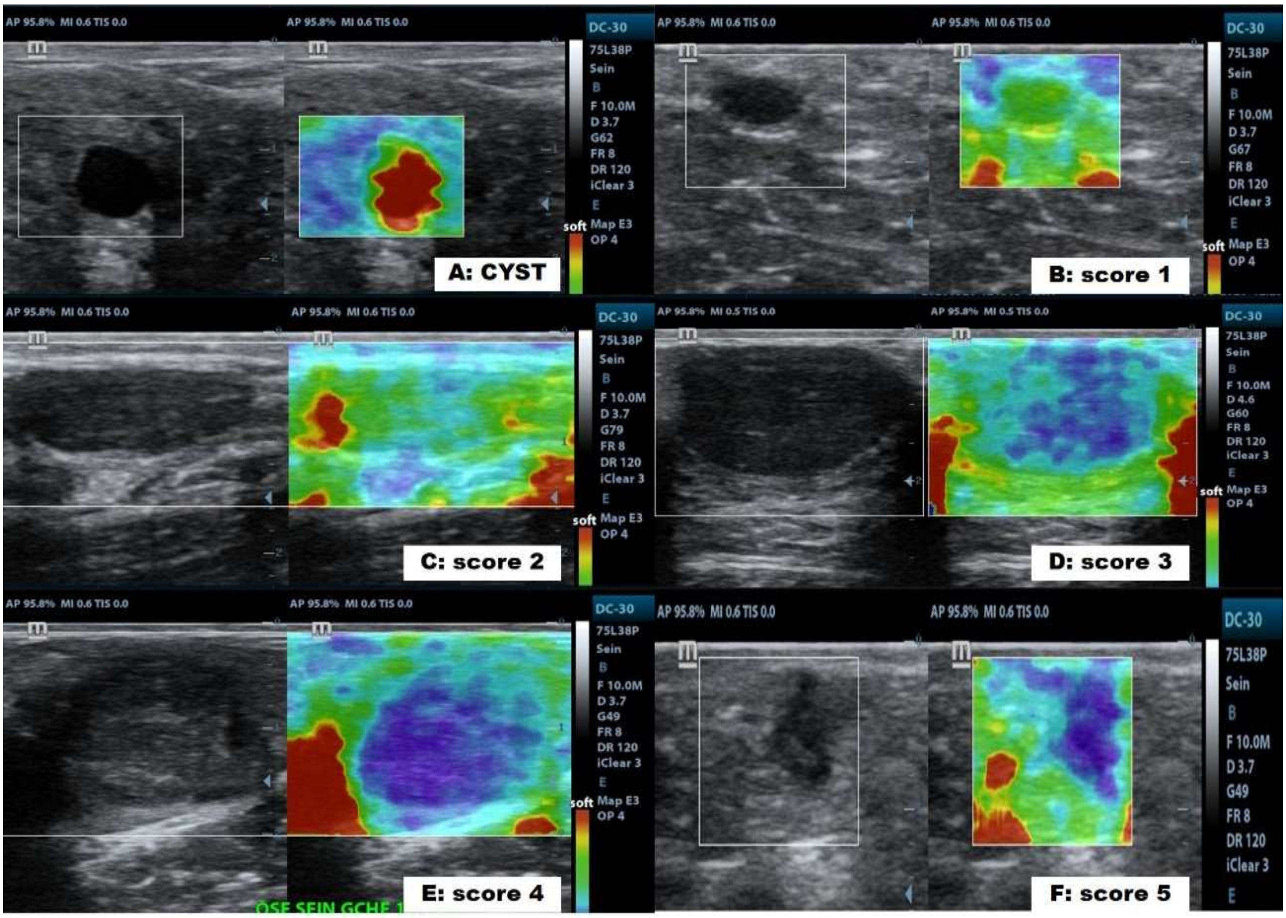

Figure 2. *Examples of breast lesions with their elasticity score.*

A: anechoic mass, with posterior reinforcement on mode-B, colored in red on the elastogram, corresponding to a cystic lesion.
B: well-defined oval tissue mass, without posterior acoustic modification classified as Birads 3. In elastography, this lesion appears uniformly green corresponding to score 1. C: solid, well-defined homogeneous hypoechoic mass, appearing in a mosaic of green and blue on the elastogram, corresponding to a score 2. D: homogeneous hypoechoic well circumscribed oval solid mass showing on the elastogram a hard central zone in blue with a deformable periphery in green (score 3). E: solid oval mass with indistinct outlines appearing entirely blue in the center, with a peripheral mosaic area on the elastogram (score 4).
F: hypoechoic solid mass with angular contours of major axis not parallel to the cutaneous plane classified Birads 4C, the color elastogram shows an entirely blue lesion in the center and in the periphery, corresponding to a score 5.

3.5. Comparison of the Two Techniques

Of the 52 lesions classified as Birads 3, 33 had a score of 2 (Table 1). There was a statistically significant difference between the distribution of the Birads class and that of the elastosonographic scores (P = 0.0001).

Table 1. *Distribution of lesions according to the Birads classification and the elastosonographic score.*

	Birads 2	Birads 3	Birads 4	Birads 5	Total
Score 1	7	11	1	0	19
Score 2	8	33	7	0	48
Score 3	9	8	1	0	18
Score 4	1	0	2	1	4
Score 5	0	0	1	1	2
Total	25	52	12	2	91
P= 0,0001					

When differentiating breast masses into benign and malignant lesions, there was a statistically significant difference between ultrasound and elastosonographic results. According to the Birads analysis, the benign masses represented 84.6% (n = 77) versus 93.4% (n = 85) according to the elasticity score (Figure 3).

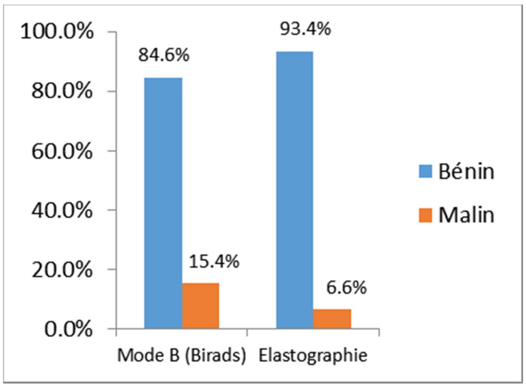

Figure 3. *Differentiation des masses mammaires par les modalités utilisées.*

Among the lesions classified Birads 4, we obtained 9 which were classified Birads 4A of which 6 had an elasticity score of 2 (Table 2).

4. Discussion

4.1. Socio-demographic Aspects

The study involved a sample of 50 patients aged between 16 and 64 years. Patients aged 20 to 29 represented 62% of the study population. The mean age of the respondents was 24.2 ± 9.1 years.

Our results differ from similar studies conducted in France by Athanasiou et al. and Demay et al. [11, 12] who noted respectively an average age of 57.6 and 59 years with extremes of 38 - 71 years and 18 - 85 years. Mohamed et al. in 2014 in Egypt found an average age of 44.8 years and extremes of 20 and 69 years. Tan et al. in Singapore found a mean age of 39 years with extremes of 13-83 years [10, 16].

4.2. Clinical Data

The palpable breast mass was the most common clinical symptom in 46 cases (92%) followed by mastodynia (38%). Demay et al, Zhu et al, Tan et al. reported a predominance of palpable nodules in respectively 55.9%, 57.6% and 70.7% [11, 16, 17]; These results corroborate those we obtained. However, Navarro et al. in Spain found a frequency of palpable masses in 42.7% [18]. Breast masses are indeed the most frequent mode of discovery of breast cancer.

A family history of breast cancer was reported by 2 patients, ie 4% of cases. This rate is much lower than 13.2% and 18.4% obtained respectively by Demay et al. in Franceand Graziano et al. in Brazil [11, 19].

4.3. Ultrasound Data

The supero-external quadrant of the breast was the site most frequently affected in 31.8% (n = 29) of the cases in our study. This rate is comparable to that found by Tan et al, who found an attack rate of 34.1% (n = 186) [16]. This topography is explained by the ever increasing amount of glandular tissue in the supero-external part of the breast [20].

We observed breast masses ranging in size from 5 mm to 35 mm, with an average size of 18.8 mm. This result is similar to those of Navarro et al. and Atabey et al. who found an average size of 18 mm (7 - 33 mm) and 19 mm (5-90 mm) respectively [18, 21]. It is however slightly higher than that of Graziano et al, who found an average lesion size of 15.6 mm (3 - 68 mm) [19].

Table 2. *Distribution of Birads 3 and 4 masses according to the elastosonographic score.*

	Birads 3	Birads 4A	Birads 4B	Birads 4C	Total
Score 1	11	1	0	0	1
Score 2	33	6	0	1	7
Score 3	08	1	0	0	1
Score 4	0	1	0	1	2
Score 5	0	0	0	1	1
Total	0	9	0	3	12

Lesions classified as Birads 3 (probably benign) were the majority in our study (57.1%, n = 52). Our result is similar to that of Mohamed et al. in Egypt who found a majority Birads 3 score (46.2%) [10]. On the other hand, Tardivon et al. in 2007 found a predominance of lesions classified as Birads 5 (39.4%, n = 48). Navarro et al. obtained a predominance of lesions classified as Birads 4 (42%, n = 52). Graziano et al. had found a predominance of Birads 4 lesions in 50.9% (n = 81) including 32 lesions classified 4A, 36 lesions classified 4B and 13 lesions classified 4C [6, 18, 19]. We did not obtain a lesion classified as Birads 4B. This was also the case in the study by Youk et al. in South Korea [22].

4.4. Elastosonographic Data

Elastosonography, also called ultrasound elastography, is a recent imaging technique making it possible to assess the hardness of tissues. It can be done in static mode or in dynamic mode. Breast elastography in static mode is a qualitative examination making it possible to assess the elasticity of the lesions. Itoh et al. proposed a 5-score classification system [23], widely used in several studies. The higher the score, the harder the lesion and the more likely it is to be malignant.

Lesions with an elasticity score of 2 represented 52.7% (n = 48) of our sample. This result is consistent with those of the studies by Navarro et al, Graziano et al. and Atabey et al. who also found a predominance of score 2 respectively in 33.9% (n = 42), 39% (n = 62) and 45.5% (n = 50) [18, 19, 21].

However, these results differ from those of Mohamed et al. and Tardivon et al. who found, respectively, a predominance of lesions with an elasticity score of 4 in 28.3% (n = 41) and 31.1% (n = 38) [6, 10].

4.5. Comparison of the Two Techniques

A missed cancer or a late diagnosis of cancer can have a decisive impact on a patient's survival. Therefore, the establishment of a well-organized diagnostic framework is essential for patients. The characterization of breast lesions by B-mode ultrasound is based mainly on morphological criteria defined by the American College of Radiology in the Bi-rads lexicon. These descriptive criteria often lead to false positives and a number of unnecessary biopsies [7, 24, 25]. Elastosonography is a recent technique that can improve the classification of these lesions and increase the specificity of ultrasound [26].

We found a significant difference between the distribution of ultrasound Birads classes and elastographic scores (p = 0.0001). Numerous studies, similar to ours, corroborate this result [10, 18, 21].

Although lesions classified as Birads 3 are probably benign, there is still a risk of malignancy for each patient (PPV <2%). Therefore, they require short-term follow-up. This is not only a source of expense but also a source of anxiety for patients. In our study, all the lesions classified as Birads 3 obtained an elasticity score of less than 3 (n = 52). In the same group of lesions, Navarro et al. found an elasticity score of less than 3 in 39 out of 40 cases. Wojcinski et al. found a lower frequency, with 78.5% of Birads 3 lesions, having an elasticity score less than 3 (139/177) [18, 27].

The same is true for lesions classified as Birads 4. In this group, the PPV varies between 2 and 95%. Thus, to consider all Birads 4 lesions as malignant would be inaccurate. The impact of such a classification is unequivocal in terms of management with the decision to take samples for diagnostic purposes, leading to a significant number of benign results. Moreover, the 5th edition of Birads divides the Birads 4 class into 3 sub-groups (4A, 4B, 4C). Classified lesions Birads 4A have a PPV between 2 and 10%. They denote lesions with a low suspicion of malignancy for which a benign pathological diagnosis is expected and would be considered concordant. In our study, 8 out of 9 lesions (88.9%) classified as Birads 4A had elasticity scores less than 3 (1 from score 1, 6 from score 2 and 1 from score 3). Our results are comparable to those of Graziano et al. who found that approximately 84% of the lesions classified as Birads 4A had a score lower than 3. However, our results are clearly superior to those of Menenez et al. who found that 50% of the lesions. Lesions classified as Birads 4A had a score less than 3 (2 with score 2 and 6 with score 3) and were all benign on histology [19, 28]. Many researchers conclude that the Birads 4A groups, a group with low suspicion of malignancy, and Birads 3 are the area where elastography has the most added value [27-29].

By differentiating benign masses (Birads 2, 3 and score 1, 2, 3) from malignant masses (Birads 4, 5 and score 4, 5), elastography showed a significantly higher capacity than ultrasound (p = 0.0002). Our results are similar to those of Mohamed et al, and Fleury et al. who also found this relationship with in addition a diagnostic precision of static elastography of 97.2% and 97.7% respectively. However Kim et al. obtained a sensitivity of elastography similar to that of B mode to differentiate masses [10, 30, 31]. According to the Birads analysis, the benign masses represented 84.62% (n = 77) versus 93.4% (n = 85) according to the elasticity score. Our result is higher but in line with those of Mohamed et al, and Navarro et al. who found respectively 54.5% and 42, 9% benign lesions in the Birads classification versus 55.2% and 58.1% in elastography [10, 18]. Tardivon et al, in his study comprising as many benign as malignant lesions on histology, found 54.1% of benign lesions on elastography versus 24.6% according to the Birads classification [6]. Graziano et al. found 27.7% of benign lesions according to the Birads classification versus 58.5% in elastography [19]. Sravani N et al. found that all the elastosonographic parameters were significantly higher in the malignant breast masses, compared to the benign lesions [32].

5. Conclusion

The semiology provided by elastography could improve lesion characterization. In fact, our study shows an association between the distributions of ultrasound aspects according to Birads and the elastographic scores. Moreover, by considering the Birdas 3 lesions as indeterminate, and the Birads 4 as suspect, the association with elastography would make it possible to clarify the classification. A histological correlation study of cases of discordance between the hardness of the lesion and the Birads 4 class would make it possible to refine the place of elastography by studying the diagnostic value of the elastographic score alone or associated with the Birads classification.

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