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Sonographic Features and Its Accuracy in Differentiating between Benign and Malignant Breast Lesions in Nigerian Women

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Abstract: This study compared the ultrasonographic features with histopathological findings in breast lesions seen at State House Clinic, Abuja, to determine the sensitivity, specificity and accuracy of ultrasound in the diagnosis of breast lesions using histopathology as gold standard. Ethical approval was obtained from the Ethical Committee of the State House Clinic, Abuja. Sonography was conducted on 150 patients aged 15 to 69 years (mean age 40years) who presented with breast lesions at State House Clinic, using Philip HD 4 machine equipped with 7.5 MHz probe. Histopathology reports of the patients were reviewed and correlated with the ultrasonography findings. American College of Radiology's Breast imaging Reporting and Data System (BI-RADS) descriptors were used to categorize the sonographic features into different BI-RADS assessment category. The BI-RADS in this study accurately predicted 94 benign breast lesions and 56 malignant lesion while histopathology identified 96 benign breast lesion and 54 malignant lesions. The difference may be attributed to the limitation of relying purely on morphological appearances. Ultrasound BI-RADS assessment from our study has sensitivity of 74.04%, specificity of 83.33%, positive predictive value (PPV) of 71.42%, negative predictive value (NPV) of 85.10% and accuracy of 0.85. When histopathology results were compared with that of BI-RADS predictions in this study, no statistically significant difference ($p > 0.05$) was observed.

Key words: Breast lesions · Malignant · Sonography · Women

INTRODUCTION

Breast cancer is one of the commonest malignant tumors in the world and is one of the leading causes of death due to cancer in women [1]. Global cancer statistics indicates rising incidence of breast cancer which is occurring at a faster rate in populations of the developing countries that previously enjoyed low incidence of the disease [2]. At present, most breast imaging is directed at early detection in order to intervene timely and reduce high mortality [3, 4]. The decline in mortality rate from breast cancer observed in developed countries was largely due to early detection and treatment [2].

Sonography has been utilized for the characterization of clinically or mammographically detected breast nodules [5-8]. Despite several positive reports on the sonographic distinction between benign and malignant breast lesion [9-12], laboratory confirmation of the breast lesion by histopathology is widely held as the gold standard. Histopathology involves an invasive technique of biopsy for both benign and malignant cases. Mammography, which uses low energy x-rays for diagnosis, is a sensitive method for detecting early breast carcinoma [13]. However, mammography has limited specificity, results in unnecessary biopsies and cannot be used effectively in resource-limited countries because of its cost [14]. Other breast imaging modalities such as magnetic resonance imaging [15] and digital mammography are not readily available in developing countries.

In majority of the sub-Saharan Africa, ultrasonography is readily available and this makes breast ultrasound (BUS) an attractive diagnostic tool. Berg and

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Gilbreath [16] demonstrated that whole-breast sonography would be a useful complement to mammography in the pre-operative evaluation of patients with breast cancers, providing a more accurate assessment of disease extent. Also the future role of sonography in breast imaging was suggested by American College of Radiology [17]. Ultrasonography does not utilize ionizing radiation and has many advantages of being affordable, readily available, repeatable, sensitive and a pre-interventional tool, [14].

The aim of this study was to differentiate between benign and malignant breast lesions based on sonographic features that confirmed later by pathologic findings in a Nigerian population to ascertain the probability that a breast lump is either benign or malignant. This will reduce the number of unnecessary biopsies and also save cost for patients.

MATERIALS AND METHOD

Sonography was performed on 150 patients, aged 15 to 69 years (mean age 40years), who presented with breast lesions at State House Clinic Abuja, using Philip HD 4 machine equipped with 5 - 7.5 MHz probe. Bilateral whole-breast sonography was conducted on each of the patients. Ethical approval was obtained from the Ethical Committee of the State House Clinic, Abuja and informed consent obtained from each of the patients before commencement of the examination. When a mass was identified the size was measured and the ultrasound features assessed and categorized. The ultrasound findings were categorized according to the Breast Imaging Report and Data System (BI-RADS) lexicon using the following tumour classification [18]: Shape (oval, round or irregular), orientation (parallel to the skin surface or not), margin (circumscribed or not, indistinct, angular, spiculated or microlobulated), echo pattern (anechoic, hypoechoic, hyperechoic or complex), posterior acoustic features (none, enhancement or shadowing), surrounding tissue change (absent or present), vascularity (none, focal or penetrating flow, or diffusely increased flow), presence of associated calcifications (none or microcalcifications in or out of a mass).

After the sonographic features listed above were evaluated, a BI-RADS category score was assigned to each lesion which ranged from 0 to 6. This score represented the final assessment of the lesion. When there were many lesions with different ultrasound findings in the same breast, the final BI-RADS' category for the breast was the highest BI-RADS' category in that breast. The ultrasound results from the left and the right breasts were combined and the more severe lesion was used to categorize the patient. A final BI-RADS score was assigned to all the subjects. Our study adopted the modified American College of Radiology [19] Breast Imaging Reporting and Data System (BI-RADS). "Positive" category were all those who had BI-RADS assessment category 4, 5 and 6. "Negative" category were all those with BIRADS assessment category 0, 1, 2 and 3. Also the age of the patients were recorded. The histopathology report of each of the patients was reviewed and the tumour categorized into benign and malignant tumour. Ultrasound assessment was evaluated against cancer outcome from histopathology report and signal detection theory applied to identify true-positive, true-negative, false-positive and false-negative reports. Data was subjected to descriptive statistics and analyzed using Chi square and analysis of variance. Probability value less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

In this study the age range of patients presenting with breast diseases was 15-69 years (Table 1) with mean of 40 years. This is similar to the result obtained by Danfulani *et.al*.,[20] in which they found the mean age of patients presenting with breast diseases in Sokoto State, Nigeria to be 41 years. Diagnosis of malignancy from histology in this study had highest frequency at age 50-59 years (27.8%), whereas BI-RADS prediction by sonography of malignancy had highest frequency at age range of 40-49 years (Table 2). This finding is in agreement with the results of Okobia *et al*., [2] where they found patients with malignancy to be from the 4th decade of life. This finding may be related to geographic or racial association. Most of the patients were within the age range of 30-39 years representing 28%. Most of the patients with benign lesions according to BI-RADS assessment (32%) and histology (32.3%) were within the age range of 30 – 39 years. Most patients (33%) diagnosed with malignant breast lesions according to BI-RADS assessment were within the age range of 40 – 49 years. However patients diagnosed by histology (27.8%) with malignant lesion were within the age range of 50 – 59.

This study found that the denser the breast, the better the diagnostic value of ultrasound. This suggests that the more fatty the breast, the less the specificity and accuracy of ultrasound. This finding is similar to that of Adeyemoye *et al.,* [21].

Table 1: Age distribution of patients presenting with breast lesions

S/N	Age Range (Yrs)	Frequency/percentage
1	<20	15 (10%)
2	20-29	15(10%)
3	30-39	42 (28%)
4	40-49	29 (19.33%)
5	50-59	31(20.67%)
6	60-69	18 (12%)
Total	<20-69	150 (100%)

Table 2: Results of ultrasound BI-RADS predictions and Histology diagnosis of the number and percentage of women detected with benign or malignant breast lesions

		Ultrasound prediction		Pathology diagnosis	
S/N	Age range	Benign	Malignant	Benign	Malignant
1	<20	13(13.83%)	2 (3.57%)	15 (15.6%)	0 (0%)
2	20-29	13(13.83%)	2 (3.57%)	14 (14.6%)	1 (1.9%)
3	30-39	30(31.92%)	12(21.43%)	31(32.3%)	11(20.4%)
4	40-49	10(10.64%)	19 (33%)	15 (15.6%)	14(25.9%)
5	50-59	16(17.02%)	15 (27%)	16 (16.7%)	15 (27.8%)
6	60-69	12(12.77%)	6(11%)	5 (5.2%)	13(24.1%)
Total	<20-69	94 (100%)	56 (100%)	96 (100%)	54 (100%)

Table 3: Results of ultrasound BI-RADS assessment compared with physical assessment in women with breast lesions

	BI-RADS	ASSESSMENT
Physical assessment of the breast	Benign Frequency (%)	Malignant Frequency (%)
Pain	7 (7.4%)	1 (1.8%)
Lump	30 (31.9%)	31 (55.4%)
Both Pain and Lump	54 (57.4%)	8 (57.4%)
Breast discharge	1 (1.1%)	8 (1.1%)
Lump and breast discharge	2 (2.1%)	8 (2.1%)
Total	94 (100%)	56 (100%)

Table 4: Relationship between size of lesion and BI-RADS assessment

	BI-RADS Assessment		
Size	Benign	Malignant	Total
0 - 1.5	8	46	54
> 1.6	86	10	96
Total	94	56	150

Pain co-existing with breast lump at the onset was the commonest symptom/complaint among patients diagnosed with benign lesions while malignant lesions mostly appeared painless at the onset (Table 3). Similarly Leung *et al*., [22] reported pain co-existing with lump as the commonest finding.

The common ultrasound features for benign lesions were oval (58.5%) followed by round (36.1%). The lesion orientation was defined with reference to the skin. It was also a very good descriptor to predict either benignity or malignancy (Table 4).

A parallel or "wider than tall" i.e. antero-posterior (AP) diameter/width ratio of size greater than 1.5cm was associated with some benign masses (85.1%). However, the remaining 14.9% of masses with parallel orientation were found to be malignant. In this case, other prominent sonographic features were used to differentiate them appropriately.

The margin is the edge or border of the lesion. A well circumscribed lesion depicts benignity. In this study, 93.6% were accurately described as benign. Margin of the lesion was among the prominent reliable descriptor for BI-RADS prediction and assignment of scores. Lesion boundary was also a very important ultrasound descriptor. It described 89.4% of lesion as having an abrupt interface which connotes benignity.

Echo pattern features that described benignity were anechoic and hyperechoic in 37.2% and 43.6% respectively. Posterior acoustic enhancement was accurate in 94.7% of the cases that best described benign lesions (Fig. 1). Surrounding tissue changes were mostly seen in malignant lesions than benign lesions.

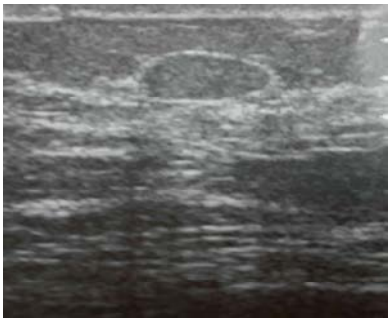

Fig. 1: Sonogram of a well circumscribed breast lesion with acoustic shadowing which turned out to be fibroadenoma on histology

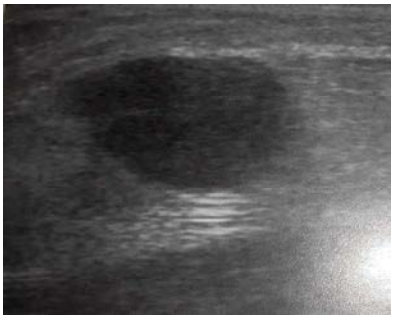

Fig. 2: Sonogram of a hypoechoic mass with irregular outline which turned out to be ductal carcinoma on histology.

The ultrasound descriptive features for malignant lesions in this study were irregular shape (66%), non parallel orientation or "Taller than wide" (71.4%), not circumscribed margin in 100% and the halo sign in 83.3%. Also hypoechoic features (76.8%), acoustic shadowing (83.9%) with architectural distorted surrounding tissue in most of the cases (Fig. 2). These findings were similar to those observed by Chen *et al*., [23], Stavros *et al.,* [24] and Mubuuke [25] in their separate studies.

This study identified two calcification out of 150 breast lesions studied. These masses turned out to be sonographically and histologically malignant lesions. However differentiation of calcification in ultrasound improved with the use of higher frequency ultrasound transducers. This finding was also shared by Soo *et al.*, [26].

The BI-RADS in this study accurately predicted 94 benign breast lesions and 56 malignant lesion while histology identified 96 breast lesion and 54 malignant lesions. The difference may be attributed to the limitation of relying purely on morphological appearances. However, applying Pearson's correlation the discrepancy in the histology results with that of BI-RADS prediction from this study, there was no statistically significant difference ($P > 0.05$).This implied that the application of BI-RADS lexicon for ultrasound characterization of breast lesion if diligently applied was good with minimal intra-observer variation. Therefore, the use of BI-RADS lexicon can provide accurate and consistent description and assessment of breast lesions.

Correlation between sonographic features and histology obtained a sensitivity of 74% in this study. This is lower than76% obtained by Adeyemoye *et al*. [21] but may be attributed to variation in the number of patients used for the studies. Adeyemoye *et al*. [21] showed that ultrasound had high sensitivity but must be used in conjunction with needle biopsy to achieve improve results and avoid unnecessary benign surgical biopsies. Dennis *et al*. [4] however advocated avoidance of biopsy based on negative imaging result.

The limitation of this study was that it concentrated only on symptomatic patients. This practice though previously used by [27], restricts selecting patients, for sonography and timely biopsy, of the palpable lesion. This study found out that there were some lesions though not palpable but could be seen in ultrasound. However, if a lesion is cancerous and has started spreading without forming a discrete mass, BI-RAD prediction using ultrasound may not properly characterize it. This may resulted in discouraging ultrasound as a screening tool. This view was also shared by [21, 28, 27].

CONCLUSION

This study showed that ultrasound has high sensitivity in differentiation of benign and malignant lesions. BI-RADS prediction based on some sonographic features was able to categorize breast diseases. The detection accuracy in this study was 80% and this suggests that biopsy can be deferred if BI-RADS assessment category is strictly followed. However, the ability to use BI-RADS to grade breast carcinoma was not achieved. The sensitivity and accuracy of ultrasound was operator and age dependent. Therefore, ultrasound may not be used as a screening tool but highly recommended as the first line imaging technique in women with breast symptoms who are less than 30 years, lactating or pregnant. Histology still remains the gold standard.

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