Commentary

BI-RADS Lexicon: An Urgent Call for the Standardization of Breast Ultrasound in Nigeria

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SUMMARY

Ultrasound technology and its ability to demonstrate breast anatomy and pathology has changed dramatically and rapidly in the last decade, sonography is now utilized to characterize and manage palpable and mammographic abnormalities.It is also useful in evaluating nipple discharge and mammary implants. Breast ultrasound (BUS) is an invaluable tool for assessing the extent of malignant disease and regional lymph nodes is also available for evaluation of the breast after breast cancer treatment. All of the above have encouraged the development of BI-RADS ultrasound to further improve and standardize Breast Sonography. This Lexicon is being presented to radiologists, breast surgeons, breast oncologists, breast pathologists, and breast sonographers.

INTRODUCTION

Imaging plays an important role in the management of breast diseases. However, imaging of the radiologically dense breasts represents a diagnostic challenge for interpreting radiologists. Breast cancer especially non-calcified breast cancer is also more likely to be missed in dense breasts than in radiologically fatty breast [1]. In addition to the decreased visibility of the lesions secondary to the increased density of the breast tissue there is probably an independent increased risk of malignancy in dense breasts. For these reasons, new diagnostic modalities have been introduced to the armamentarium of investigation protocols in order to improve the chances of visualization of breast malignancies. These include MRI, CT, Digital Mammography, Colour Doppler and Ultrasound of the Breast. Mammography though remains the most sensitive method for detecting pre-clinical breast carcinoma, its limited specificity results in the need to biopsy many lesions to determine whether they are benign or malignant [2, 3].

In the United States and Europe, imaging the breast with MRI and digital mammography is common practice. In the majority of the Sub- Saharan countries, the absence of these state- of- the art imaging modalities makes Breast Ultrasound (BUS) an attractive alternative diagnostic tool, now that some studies suggest a future role for Sonography in breast screening [4]. Ultrasonography does not utilize ionizing radiation, it is affordable, readily available, repeatable and sensitive.

The characterization of mammographic lesions into categories was developed by the American College of Radiology (ACR) for reporting and data analysis within the United States of America [5]. It is referred to as Breast Imaging Reporting and Data System (BI-RADS) categories. The growing use of ultrasonography worldwide created this need for a standardized method for lesion characterization, description and reporting [6].

In addition, it was hoped that this would enable easy entry of data into databases for future analysis. Finally, assignment of an ACR BI-RADS category was intended to standardize management decision based on final BI-RADS assessment. This Lexicon though not perfect has been successfully used in mammography.

It is believed that with minor modifications the Lexicon can be used directly for BUS and there

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is every reason to expect that sonographic BI-RADS categorization will be as successful as mammography has been. The general role of BUS is to make a more specific diagnosis than could be made with clinical and mammographic findings. Other more specific goals are preventing unnecessary negative biopsies, preventing unnecessary short-interval follow-up, guiding interventional procedures, improving clinical skills, finding cancer that was missed or underclassified by mammography and staging cancers by determining the extent of the malignant disease [7, 8].

Based on the success of BI-RADS with mammography, the development of a lexicon for breast ultrasound became a necessity. Infact, it is now a high priority. Though breast sonography is in its infancy in Nigeria it is pertinent to standardize this imaging technique in order to meet International standards and enhance shared terminology among referring physicians, radiologists and patients which will in turn give better understanding for diagnosis and management implications [9].

Furthermore, this lexicon will provide a basis for validation of outcomes across multiple centers, as studies in Nigeria can be adequately compared or correlated with other centers in America and Europe. There is therefore an urgent need to adopt this Lexicon, Breast Imaging Reporting and Data System (BI-RADS) Ultrasound.

It is against this background that this communication is being presented to acquaint radiologists in Nigeria with the current trend in breast sonography and reporting.

Technique of Breast Ultrasound (BUS)

Indications for breast sonography include the following: the initial evaluation of palpable abnormalities in women under 30 years, initial identification and characterization of palpable and non palpable abnormalities, guidance of interventional procedures and evaluation of problems associated with breast implants[4, 5]. The growing use of ultrasonography world-wide created the need for a standardized method for lesion characterization, description and reporting [6], especially now that studies suggest future roles for sonography in breast screening [7].

The use of this ultrasound lexicon is predicated on an excellent sonographic technique using a linear transducer whose center frequency ranges between 7-12 MHz. The patient is scanned supine in the contra-lateral posterior oblique position. The patient is asked to position her ipsilateral arm above her head and her ipsilateral hand behind her head. This positioning in combination with a variable degree of compression of the breast with the transducer, accomplishes two important things. Firstly, it thins the area of the breast being scanned to the greatest degree possible, ensuring that the transducer used for breast ultrasound (BUS) will adequately penetrate to the chest wall. Secondly, it pulls the normally conically shaped tissue planes of the breast into a horizontal orientation that is nearly parallel to the transducer surface perpendicular to the ultrasound beam. This positioning technique minimizes the amount of image degradation.

Scanning Planes

Longitudinal and transverse scan planes may be sufficient for a generalized scan, however the demonstration of normal ductal anatomy requires scanning in the radial scan planes because the normal mammary ducts are normally orientated radially away from the nipple.

Lesion Localization

The method used has three desriptors: a clock face-localisation, similar to that of the American College of Radiology (ACR) Lexicon; a description of how far from the nipple the lesion lies and a description of the depth of the lesion. This is achieved using a descriptor with five components namely, the breast side (right or left), the clock-face location, the distance from the nipple, the depth of the lesion and the scan plane orientation descriptor. Several previous studies[10, 11, 12] have shown that these multiple features must be analyzed to achieve as great specificity as possible in sonographic characterization.

Axillary Lymphadenopathy

In whole breast ultrasound, the study is not completed until a look is taken at the axilla. In sonomammography the normal node measures about 1cm. It is also bean shaped with an echogenic hilum and a hypoechoic cortex giving the usual cortico-medullary differentiation.

Doppler Studies

Power ultrasound and Colour Doppler ultrasound depicts the location of blood vessels when planning a percutaneous breast biopsy. Description of the vascularity of the lesion is however not a reliable predictor of benignity or malignancy [12, 13, 14].

Sonographic Features

The primary sonographic features of a lesion include the shape, orientation margins, matrix echogenicity and attenuation (Table 1). These features should be described and applied in a consistent fashion. In addition, secondary association findings including architectural distortion, retraction or angulation of Cooper's ligaments, dilated ducts, calcifications and changes in the skin, subcutaneous fat and pectoral muscle should also be recorded. These sonographic features of masses have been enumerated previously [10, 11, 12].

The most appropriate descriptor for each category of characteristics should be applied when describing a lesion. Documentation should be performed in accordance with the American College of Radiology standards.

When a solid lesion is present, careful analysis of its contour, margins matrix and attenuation may help in its classification. Starvos *et al* [10] proposed three categories of solid lesions that could be classified as BI-RADS Category 3 (probably benign). They are masses with intense and uniform hyperechogenicity relative to fat, masses with ellipsoid shape and a smooth margin and masses with two or three gentle lobulations and also a thin smooth margin. Each of these masses has an individual negative predictive value for malignancy of 98.8% - 100% [10].

Margin

For solid masses, irregularity of shape and margin dominate other features suggesting malignancy with a Positive Predictive Value(PPV) of malignancy of 86% - 93%[10,11]. The lesions with the other features of lower specificity are classified as BI-RADS category 4 or 5, Biopsy is recommended to confirm diagnosis.

Orientation

If the long axis of a mass is not parallel to the skin, synonymously termed taller than it is wide; the likelihood of malignancy is 62-81%[10,11], it is commonly seen in cancers < 1cm in size[10]. Most fibroadenomas and some cancers are oriented with their long axis parallel to the skin (wider than tall)[15].

Echotexture/Echopatter

This is defined relative to the fibroglandular tissue of the breast hypoechoic masses have lower echoes to the fibroglandular tissue while isoechoic masses have echoes equal to the fibroglandular tissue. Echopattern appears to be less helpful in differentiating benign from malignant solid masses[15], as most masses are usually hypoechoic.

Posterior Acoustic Features

Acoustic attenuation or shadowing is suspicious for malignancy. As many as 21% of benign lesions will show shadowing. Similarly, acoustic enhancement while common in benign lesions may be present in up to 42% of cancers.

Vascularity

The description of the vascularity of the lesion is not a required standard as no reliable distinction has yet been made between benign and malignant lesions on this basis[13, 14]. The vascularity of the lesion is normally described as either the same, increased or decreased when compared to that of the surrounding parenchyma.

The BI-RADS ultrasound descriptors are illustrated in Table 1. In referring to this table, it is important to re-emphasize the fact that the greatest specificity is achieved by the evaluation of multiple features of the mass rather than any single attribute.

Final Assessment

As with mammography, a BI-RADS final assessment and recommendation should be specified (Table 2). When BUS is performed alone or as an adjunct to mammography, one final assessment and

Table 1:

ACR-BI-RADS®-US Lexicon Classification Form

For each of the following categories, select the term that best describes the dominant lesion feature.
Wherever possible, definitions and descriptions used in BI-RADS for mammography will be applied to ultrasound. This form is for data collection and does not constitute a written Ultrasound report

A. Masses: A mass occupies space and should be seen in two different projections.

Shape *(select one)*	**Description**
❑ Oval	Elliptical or egg-shaped (may include 2 or 3 undulations, i.e."gently lobulated" or "macrolobulated")
❑ Round	Spherical, ball-shaped, circular, or globular
❑ Irregular	Neither round nor oval in shape

Orientation *(select one)*	**Description**
❑ Parallel	Long axis of lesion parallels the skin line ("wider than tall" or horizontal)
❑ Not Parallel	No long axis, or axis not oriented along the skin line ("taller than wide" or vertical)

Margin *(select one)*	**Description**
❑ Circumscribed	A margin that is well defined or sharp with an abrupt transition between the lesion and surrounding tissue
❑ Not Circumscribed*	The mass has one or more of the following features:: indistinct, angular, microlobulated or spiculated
❑ *Indistinct*	No clear demarcation between a mass and its surrounding tissue
❑ *Angular*	Some or all of the margin has sharp corners, often forming acute angles
❑ *Microlobulated*	Short cycle undulations impart a scalloped appearance to the margin of the mass
❑ *Spiculated*	Margin is formed or characterized by sharp lines projecting from the mass

Lesion Boundary *(select one)*	**Description**
❑ Abrupt interface	The sharp demarcation between the lesion and surrounding tissue can be imperceptible or a distinct well-defined echogenic rim of any thickness
❑ Echogenic Halo	No sharp demarcation between the mass and surrounding tissue, which is bridged by an echogenic transition zone.

Echo Pattern *(select one)*	**Description**
❑ Anechoic	Without internal echoes
❑ Hyperechoic	Having increased echogenicity relative to fat or equal to fibroglandular tissue
❑ Complex	Mass contains both anechoic (cystic) and echogenic (solid) components
❑ Hypoechoic	Defined relative to fat; masses are characterized by low-level echoes throughout (e.g. Appearance of a complicated cyst or fibroadenoma)
❑ Isoechoic	Having the same echogenicity as fat (a complicated cyst or fibroadenoma may be isoechoic or hypoechoic)

Posterior Acoustic Features *(select one)*	**Description**
❑ No posterior acoustic features	No posterior shadowing or enhancement
❑ Enhancement	Increased posterior echoes
❑ Shadowing	Decreased posterior echoes; excluding edge shadows
❑ Combined pattern	More than one pattern of posterior attenuation, both shadowing and enhancement

*Note: Irregular is used as descriptor of shape rather than margin

Surrounding Tissue	**Description**
Identifiable effect *(select all that apply)*	
❑ Duct changes	Abdominal caliber and/or arborization
❑ Cooper's ligament changes	Straightening or thickening of Cooper's ligaments
❑ Edema	Increased echogenicity of surrounding tissue: reticulated pattern of angular, hypoechoic lines
❑ Architectural distortion	Distortion of normal anatomic planes
❑ Skin thickening	Focal or diffuse skin thickening-Normal skin is 2 mm or less in thickness except in the periareola area and lower breasts
❑ Skin retraction/irregularity	Skin surface is concave or ill-defined, and appears pulled in

B. Calcifications: Calcifications are poorly characterized with ultrasound but can be recognized particularly in a mass.

Calcifications	**Description**
If present (*select all that apply)*	
❑ Macrocalcifications	Greater than or equal to 0.5 mm in size
❑ Microcalcifications out of mass	Echogenic foci that do not occupy the entire acoustic beam and do not shadow. Less than 0.5 mm in diameter.
❑ Microcalcifications in mass	Embedded in a mass, microcalcifiations are well depicted. The punctate, hyperechoic foci will be conspicuous in a hypoechoic mass

C. Special Cases: Special cases are those with a unique diagnosis or finding.

Special cases *(select all that apply)*	**Description**
❑ Mass in or on skin	These masses are clinically apparent and may include sebaceous or epidermal inclusion cysts, keloids, moles and neurofibromas.
❑ Foreign body	May include marker clips, coil, wire, catheter sleeves, silicone, and metal or glass related to trauma
❑ Lymph nodes - intramammary	Lymph nodes resemble small kidneys with an echogenic hilus and hypoechoic-surrounding cortex. Found in the breast, including axilla
❑ Lymph nodes - axillary	Lymph nodes resemble small kidneys with an echogenic hilus and hypoechoic-surrounding cortex. Found in the breast, including axilla

D. Vascularity

Vascularity (select one)

- ❑ Not present or assessed
- ❑ Present in lesion
- ❑ Present immediately adjacent to lesion
- ❑ Diffusely increased vascularity in surrounding tissue

Table2: BI-RADS; ULTRASOUND Final Assessment Categories

Categories/Codes	Assessment	Recommendations
0	Incomplete	Needs additional imaging evaluation
1	Negative	No lesion found
2	Benign find	No malignant features
3	Probably benign finding	Low probability of malignancy e.g. fibroadenoma
4.	Suspicious abnormality	Intermediate probability of malignancy
5.	Highly suggestive of malignancy	High probability of malignancy (appropriate action should be taken including tissue biopsy)
6.	Known Cancer	Biopsy proven malignancy definitive therapy (appropriate action should be taken).

management recommendation should be specified as illustrated in fig. 1.

caused by sonographically normal-appearing fibrous tissue (BI-RADS 1), two simple cysts (BI-RADS 2) and one nodule caused by a probably benign

Fig. 1: Mass lesion. Breast ultrasound. **Shape;** spherical, **Orientaion:** round,(Does not have one axis longer than the other) and therefore classified as non paralle. **Margin;** circumscribed, distinct and smooth. **Echogenicity:** homogenous and hypoechoic. Note the shadow enhanchment posterioly consistent with a typical cyst. **Final assessment** BI-RADS 2. A benign finding with no malignant feature.

This final assessment and management should be based on the most suspicious features present. In like manner, when there are many different ultrasound findings or lesions in the same breast, the summary BI-RADS category for the entire breast should always be the highest BI-RADS category in that breast. In other words, if there is a palpable lump solid nodule (BI-RADS 3), the BI-RADS category for the entire study should be BI-RADS 3.

REFERENCES

1. Marla R. Hersh. Imaging the Dense Breast Appl Radiol 33(1): 22 –26, 2004.
2. Rosenberg AL, Schwartz GF, Feig SA, *et*

al Clinically occult breast lesions: Localization and significance. Radiology 1987; 162: 167 – 170

3. Bassett LW, Liu TH, Giuliano AE *et al:* The prevalence of carcinoma in palpable vs. impalpable mammographically detected lesions.AJR AMJ Roentgenol 1991; 157: 21 – 24

4. ACR Standard for the Performance of Breast Ultrasound Examination. ACR Standards, VA American College of Radiology, 2000; 389 - 392

5. Merritt CRB: The Breast Nodule in Ultrasound: A practical Approach to Clinical Problems (Ch 52) in Bluth EI, Arger P, Benson et al (eds). A practical Approach to Clinical Problems. New York, Theme, 2000.

6. Baker JA Kornguth PJ, 500 MS *et al.* Sonography of solid breast lesions. Observer variability of lesion description and assessment. AJR AMJ Roentgenol 1999; 172: 1621 – 1625.

7. Rotten D. Marc Levaillant, J., Lefloch, J.P., Constancis E. and Andre J.M.: Mass screening for breast cancer with sonomammography; a prospective study.European Journal of Obstetrics and Gynaecology and Reproductive Biology, 1988; 28; 257 – 267.

8. American College of Radiology (ACR): Breast Imaging Reporting and Data System (BI-RADS™) (ed 3) Reston, VA, American College of Radiology, 1998

9. Mandelson, EB. Berg. N. A., Merritt CRB. Towards a Standardized Breast Ultrasound Lexicon
BI-RADS: Ultrasound Seminars in Roentgenology, 2001; vol. xxxvi, 3: 217 – 225

10. Starvos AT, Thickmen D, Rapp CL *et al*: Solid breast nodules; Use of Sonography to distinguish between benign and malignant lesions. Radiology 1995; 196: 123 – 134.

11. High definition imaging: The role of Ultrasound in the diagnosis of breast cancer; Contribution
of US as an adjunct to Mammography. Radiology 1999; 213: 413 – 422.

12. Cole-Beuglet C, Soriano RZ, Kurtz AB *et al:* Ultrasound analysis of 104 primary breast carcinomas classified according to histopathologic type. Radiology1983; 147: 191 – 196.

13. Mc Nicholas MM, Mercer PM, Miller JC *et al:* All colour Doppler Sonography in the evaluation of palpable breast masses. AJR AMJ Roentgenol IU: 1993; 765 – 771.

14. Congrove D.O, Kedar RP, Bamper JC *et al*: Breast diseases: Colour Doppler in differential diagnosis. Radiology 1993; 189: 99 – 104.

15. Skagne P, Engedal K: Analysis of Sonographic features in the differentiation of fibroadenoma and invasive ductal carcinoma. AJR AMJ Roentgenol 170: 109 – 114, 1998