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...
is every reason to expect that sonographic BI-RADS
categorization will be as successful as mammogra-
phy 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 fol-
low-up, guiding interventional procedures, improve-
ing clinical skills, finding cancer that was missed or
underclassified by mammography and staging can-
cers by determining the extent of the malignant dis-
ease [7,8]

Based on the success of BI-RADS with
mammography, the development of a lexicon for
breast ultrasound became a necessity. Indeed, 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 ba-
sis for validation of outcomes across multiple cen-
ters, as studies in Nigeria can be adequately com-
pared 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 com-
munication is being presented to acquaint radiolo-
gists in Nigeria with the current trend in breast
sonography and reporting.

Technique of Breast Ultrasound (BUS)
Indications for breast sonography include the fol-
lowing: the initial evaluation of palpable abnor-
malities in women under 30 years, initial identifica-
tion 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 predi-
cated on an excellent sonographic technique using a
linear transducer whose center frequency ranges be-
tween 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 de-
gree of compression of the breast with the trans-
ducer, 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 ultra-
sound beam. This positioning technique minimizes
the amount of image degradation.

Scanning Planes
Longitudinal and transverse scan planes may be suf-
cient for a generalized scan, however the demon-
stration of normal ductal anatomy requires scanning
in the radial scan planes because the normal mam-
nary ducts are normally orientated radially away from
the nipple.

Lesion Localization
The method used has three descriptors: 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 dis-
tance from the nipple, the depth of the lesion and
the scan plane orientation descriptor. Several pre-
vious studies[10,11,12] have shown that these
multiple features must be analyzed to achieve as great
specificity as possible in sonographic characteriza-
tion.

Axillary Lymphadenopathy
In whole breast ultrasound, the study is not com-
pleted until a look is taken at the axilla. In
sonomammography the normal node measures
about 1 cm. 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 ellipsoidal 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].

**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 <1 cm 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.

<table>
<thead>
<tr>
<th>Shape (select one)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oval</td>
<td>Elliptical or egg-shaped (may include 2 or 3 undulations, i.e. &quot;gently lobulated&quot; or &quot;macrolobulated&quot;)</td>
</tr>
<tr>
<td>Round</td>
<td>Spherical, ball-shaped, circular, or globular</td>
</tr>
<tr>
<td>Irregular</td>
<td>Neither round nor oval in shape</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orientation (select one)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel</td>
<td>Long axis of lesion parallels the skin line (&quot;wider than tall&quot; or horizontal)</td>
</tr>
<tr>
<td>Not Parallel</td>
<td>No long axis, or axis not oriented along the skin line (&quot;taller than wide&quot; or vertical)</td>
</tr>
</tbody>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Posterior Acoustic Features (select one)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No posterior acoustic features</td>
<td>No posterior shadowing or enhancement</td>
</tr>
<tr>
<td>Enhancement</td>
<td>Increased posterior echoes</td>
</tr>
<tr>
<td>Shadowing</td>
<td>Decreased posterior echoes; excluding edge shadows</td>
</tr>
<tr>
<td>Combined pattern</td>
<td>More than one pattern of posterior attenuation, both shadowing and enhancement</td>
</tr>
</tbody>
</table>

*Note: Irregular is used as descriptor of shape rather than margin*
Surrounding Tissue
Identifiable effect (select all that apply)
☐ Duct changes
☐ Cooper’s ligament changes
☐ Edema
☐ Architectural distortion
☐ Skin thickening
☐ Skin retraction/irregularity

Description
Abdominal caliber and/or arborization
Straightening or thickening of Cooper’s ligaments
Increased echogenicity of surrounding tissue: reticulated pattern of angular, hypoechoic lines
Distortion of normal anatomic planes
Focal or diffuse skin thickening—Normal skin is 2 mm or less in thickness except in the periareola area and lower breasts
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
If present (select all that apply)
☐ Macrocollections
☐ Microcalcifications out of mass
☐ Microcalcifications in mass

Description
Greater than or equal to 0.5 mm in size
Echogenic foci that do not occupy the entire acoustic beam and do not shadow. Less than 0.5 mm in diameter.
Embedded in a mass, microcalcifications 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)
☐ Mass in or on skin
☐ Foreign body
☐ Lymph nodes - intramammary
☐ Lymph nodes - axillary

Description
These masses are clinically apparent and may include sebaceous or epidermal inclusion cysts, keloids, moles and neurofibromas.
May include marker clips, coil, wire, catheter sleeves, silicone, and metal or glass related to trauma
Lymph nodes resemble small kidneys with an echogenic hilus and hypoechoic-surrounding cortex. Found in the breast, including axilla
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
**BI-RADS Lexicon**

**Table 2: BI-RADS; ULTRASOUND Final Assessment Categories**

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

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

**Fig. 1:** Mass lesion. Breast ultrasound. **Shape:** spherical, **Orientation:** round (does not have one axis longer than the other) and therefore classified as non-parallel. **Margin:** circumscribed, distinct and smooth. **Echogenicity:** homogenous and hypoechoic. Note the shadow enhancement posteriorly 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 caused by sonographically normal-appearing fibrous tissue (BI-RADS 1), two simple cysts (BI-RADS 2) and one nodule caused by a probably benign solid nodule (BI-RADS 3), the BI-RADS category for the entire study should be BI-RADS 3.

**REFERENCES**

2. Rosenberg AL, Schwartz GF, Feig SA, et