A Review of Breast Calcifications on Mammography in a Tertiary Health Institution in Nigeria

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Abstract

Background

Breast calcifications seen on mammograms may be associated with benign or malignant conditions which require accurate characterization for treatment and screening purposes. This study was undertaken to review mammographic calcifications.

Materials and Methods

A descriptive study of all mammograms taken in the radiology department of a tertiary institution within an 11 month period in 2009 was done, using a Villa Systemi stereotactic mammography machine and Concept MC Utrasound Scan machine. Biopsies were performed where indicated and histology results were compared with radiological findings. Data was analyzed using the Epi-info statistical software.

Results

Out of the 248 patients assessed, the predominant presenting symptoms were breast pain (30.2%) and breast lump (27.4%).

While assessing the mammograms, various types of calcifications described as skin (17.0%); worm-like (4.3%); coarse (16.0%); popcorn (6.4%); rod like (8.5%); milk (5.3%); rim (4.3%); vascular (20.2%); micro- 12(12.8%); and widespread pleomorphic calcifications (5.3%) were seen. Calcifications were commoner in the lower quadrant and were evenly distributed in the inner and outer quadrants. Histology revealed that all the widespread pleomorphic calcifications and 75% of the micro-calcifications seen were malignant.

Conclusion

This study confirms that calcifications are commonly seen on mammograms with micro- and pleomorphic calcifications as common features in malignant breast lesions.

Key words: *Mammography, breast, calcifications*

Introduction

Breast calcifications have been known to occur as a result of calcium deposits within the breast tissue.[1] They are seen as white dots or specs on mammograms which are often impalpable. Breast calcifications appear to be common in all women especially after menopause.[2,3] Though calcifications are usually not cancerous, some may be.[2, 3] The prevalence of vascular calcification, which are benign, ranges from 9-17% and it increases with age, exceeding 50% in women 65 years and above.[4]

High quality mammography is a valuable diagnostic tool for the identification of breast calcifications.[1, 5] Mammographic detection of calcification remains an invaluable means of discovering non-palpable breast malignancy.[6]

The diagnosis of breast cancer on mammograms is based on the depiction of pleomorphic or fine, linear micro-calcifications, irregularly shaped masses with ill-defined or spiculated borders and focal architectural distortion.[7] Leborgne in 1951, first demonstrated that calcifications seen on mammograms were associated with cancer.[5, 8]

This study is aimed at describing the various types, patterns and distribution of breast calcifications seen on mammography in a tertiary hospital in Lagos, with some literature review.

Materials and Methods

A descriptive study of all mammograms taken from February to December 2009 in the radiology department of a tertiary institution was assessed using a Villa Systemi stereotactic mammography machine. The routine Cephalo-caudal (CC) and Medio-lateral Oblique (MLO) views were taken while the magnification and spot compression views were done when indicated. Ultrasound scan was done in cases of suspected cysts using a Dynamic Imaging Dedicated Concept MC Ultrasound scan machine. Whenever biopsy was clinically or radiologically indicated and performed, histology results were compared with radiological findings. A data sheet to show the types, patterns and distribution of calcifications was made and data was analyzed with the aid of Epi-info statistical software. The study was approved by the research and ethics committee of the hospital and all patients consented to the study protocol.

Results

A total of 248 mammograms were examined. The ages ranged between 19 to 85 years, (**Table 1**) with a mean of 49.48 $\pm$ 9.34 years. The mean weight and height were 76.78kg and 1.64 $\pm$ 0.123m respectively. Over half (62.5%) of the respondents were within reproductive age group, while less than 10% had been menopausal for more than 10 years (**Table 11**). The majority (99.2%) of participants had breast-fed their children and about 10.1% had a family history of breast cancer.

Of the total participants, 3.2% gave a history of mastectomy, 0.8% had had cystectomy and less than 5% had had lumpectomy. The major presenting symptoms were breast pain (30.2%), breast lump (27.4%) and nipple discharge in (12.1%) of cases (**Table 111**). Further assessment of mammograms revealed parenchymal distortion in 6.0% of patients, skin thickening in 6.9% and masses in 25.4% of all participants. About 12% of the participants had enlarged lymph nodes.

A total of ten types of calcifications were seen in one or both breasts and about a quarter (22.3%) had accompanying masses (**Table 1V**). About 94 forms of calcification were seen and they were described as skin; worm-like; coarse; popcorn (**Figures 1, 2**); rod-like (**Figure 3**); milk (**Figure 1**); rim; vascular; micro-; (**Figure 4**) and widespread pleomorphic calcifications. Amongst those with vascular calcifications, the majority (63.2%) were bilateral while the rest were seen only in the left breast. Almost all (89.5%) of the patients who had vascular calcifications were above 50 years of age.

Most (42.6%) calcifications were seen in the lower, outer or inner quadrant (**Table V**) and almost half of the calcifications (40.4%) were seen in menopausal women. All the widespread pleomorphic calcifications and about 75% of the micro-calcifications diagnosed by mammography were confirmed malignant by histology. About 73% of the cysts and all abscesses were confirmed by ultrasound. In addition, all the dilated breast ducts seen in mammography were confirmed by ultrasound, (**Table V1**).

Discussion

Breast calcifications, commonly seen while assessing mammograms, constitute a major determinant for benign and malignant breast lesions. False positive results can sometimes be observed as good quality mammography may interpret 5%-10% of all screening examinations as abnormal. Ninety percent of women with abnormal results, however, may not have breast cancer.[9]

Kerlikowske et al[9] opined that apart from breast masses, calcifications are the most common and worrisome findings encountered on screening mammography, as was confirmed in the present study. Calcifications can be produced from cell secretion or from necrotic cellular debris.[10] They may be intra-mammary; within or around the ducts; within the lobules; in vascular structures; in interlobular connective tissue or fat. They may be found in skin or be associated with a mass.[10] Twenty two percent of the calcifications in this study had associated masses.

Calcifications are the smallest structures seen on mammograms[3] and it is estimated that about 20-30% of cases prove to be cancerous. Most calcifications are not perceptible initially and may therefore be radiologically invisible.[10] The smallest visible calcification on a mammogram is approximately 0.2 – 0.3mm.[10] Calcifications 0.5mm or less in diameter have a high probability of malignancy while those 2.0mm or more tend to be benign. According to Nguyen, calcifications less than four in number will rarely lead to the detection of breast cancer.[10] The general rule is that larger and spherical calcifications of uniform size have a higher probability of being associated with a benign process, while smaller, irregular, pleomorphic, branching calcifications, heterogeneous in size and morphology are more often associated with a malignant process.[10] The majority (75%) of the micro-calcifications and all the pleomorphic calcifications seen in this study were confirmed malignant by histology (**Table V1**).

Involuting fibroadenoma may show popcorn calcifications which are usually due to hyaline degeneration of a fibroadenoma with calcification starting at the periphery and extending centrally.[3,5,6,11] Three of the popcorn calcifications in this study were proven to be fibroadenoma on histology, confirming the findings of Tse et al[6] that fibroadenomas may be associated with large popcorn calcifications. The detection and characterization of calcification is especially important in non palpable breast masses.[6]

Different pathological entities may give rise to small calcifications occurring in clusters.[6] Most of the breast calcifications seen by radiologists are benign, [1, 12] as was confirmed in this study. The radiologist must be able to identify typically benign calcifications to avoid unnecessary interventions and reduce patients' anxiety.[1]

An analysis of the characteristics of calcifications may aid the prediction of tumor size and grade, and the presence of invasion.[6] "Scattered" and "Casting" calcifications may indicate malignancy.[13] If calcifications are clustered, it is important to analyze their forms. Teacup, milk or pearl type of calcifications tend to be benign [6] while granular forms are likely to be malignant.[13] Calcifications may also be analyzed according to their sizes, shapes, number and distribution.[10]

Calcifications are broadly grouped into benign or malignant.[6, 10] Typically, benign calcifications include lucent centered skin calcifications which are usually rounded; and lucent centered calcifications at the periphery of the breast especially in the inferior, posterior and medial aspects.[3, 5, 11]

Calcifications that maintain a fixed relationship to each other when mammograms are compared are usually dermal. In this study, skin calcifications constituted the second commonest while the vascular variant was the commonest type.

Egg shell or rim calcifications are usually less than 1mm in thickness and these are seen on cyst walls. Rim calcifications are thin and appear as calcium deposits on the surface of a sphere. Pam et al stated that calcification in the wall of a cyst is the commonest cause of rim calcification, and this was corroborated in this study in which three of the cysts confirmed by ultrasound had calcified rims.

Calcifications can further be described as diffuse; scattered; regional; grouped or clustered. Linear calcification is arranged in a line that may branch while "segmental" calcification suggests deposits within the ducts and its branches. These are worrisome.[6] Calcifications larger than 1mm, smooth, round, dense, scattered over a large area, and bilateral are considered benign.[6] The popcorn, skin, milk and vascular calcifications in this study fell into that category. Villiers et al[12] stated that calcifications suggestive of malignancy prove to be cancer in about 30% cases and therefore same should be biopsied. The pleomorphic and micro- calcifications in the present study confirmed this finding. It was also reported that about 15% of women with non palpable cancer will have a diagnostic mammography examination that shows no evidence of cancer.[9] Earlier

studies reported that mammography showed micro-calcifications in 30% to 50% of cases of breast disease contrary to the findings in the present study where only 12.8% of micro-calcification were found.[8] Sun et al[8] also stated that micro-calcifications may be the only evidence for diagnosis in 4% -10% of cases of early breast cancer. Therefore, micro-calcification plays a very important role in detection of breast cancer especially early stages of breast cancer[8]

Malignant calcifications on the other hand may be clustered or linear. Mayo clinic newsletter in 2008 stated that micro-calcifications are almost always noncancerous and require no further testing or follow up.[2] This is contrary to findings in this study where majority of the micro-calcifications seen were histologically malignant **(Table 6)**.

"Alignment" of micro-calcification is another sinister sign suggesting malignancy such as ductal carcinoma in-situ and invasive ductal carcinoma. Evelling et al[4], found vascular calcifications in 9.1% of mammograms which is contrary to findings in this study, where about 20% was seen. The frequency of vascular calcifications rises with increasing age.[14] Some literature have shown that vascular calcifications in the breast are associated with chronic diseases such as diabetes, systemic arterial hypertension, coronary artery disease, kidney failure, autonomic neuropathy and hypervitaminosis D.[4, 14]

Cetin et al showed that diabetic women had a greater risk of vascular calcifications in the breast.[4] These findings were corroborated by Crystal et al who found that the presence of calcifications seen in mammography, was significantly associated with the existence of coronary artery disease.[4] This may suggest that mammography might be a very important screening method for coronary artery disease in women.[4] Furthermore, Topal et al[14] detected Breast Arterial Calcification (BAC) in mammograms of 49 (39.8%) subjects, which is much higher than the findings in this study. The ages and duration of menopause in those with BAC were significantly greater than those without BAC ($p < 0.001$).[14] This study however supports Nawalada[5] and Stephens[11] who claim that vascular calcifications appear to be commoner in older women. They tend to be secondary to medial sclerosis, showing as a train-like calcification which may be confused with ductal calcifications.[3, 5, 11]

Conclusion

This study confirms that calcifications are frequently encountered on mammograms and that the micro- and pleomorphic calcifications are pointers to malignancy. Generally calcifications were most often seen in the lower inner or outer quadrants. They may exist with or without a soft tissue mass.

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Table I: Age distribution of the subjects

Age (years)	Frequency (No.)	Percent %
≤ 20	1	0.4
21 – 30	2	0.8
31 – 40	30	12.1
41 - 50	116	46.8
51 - 60	69	27.8
61 - 70	25	10.1
71 - 80	4	1.6
Above 81	1	0.4
Total	**248**	**100.0**

Table 11: Menstrual History of participants

Menstrual Status	Frequency (No.)	Percent %
Still Menstruating	155	62.5
1 – 10 years post menopause	72	29.0
> **10 years post menopause**	21	8.5
Total	**248**	**100.0**

Table 111: Presenting Symptoms

Symptom(s)	Frequency (No.)	Percent %
PAIN		
Present	75	30.2
Absent	173	69.8
LOCATION OF PAIN		
Right Breast	20	26.7
Left Breast	24	32.0
Both Breasts	31	41.3
DISCHARGE		
Present	30	12.1
Absent	218	87.9
TYPES OF DISCHARGE		
Purulent	5	16.7
Milky (non-lactating)	9	30.0
Milk (lactating)	6	20.0
Blood	10	33.3
NIPPLE SORE		
Present	1	0.4
Absent	247	99.6
LUMP		
Present	68	27.4
Absent	180	72.6
LOCATION OF LUMP		
One breast	53	77.9
Both breasts	4	5.9
Axilla	5	7.4
Nipple	4	5.9
Areola	2	2.9

Table 1V: Mammographic Findings

Types of Calcification			Coexisting Mass	
	Frequency (No.)	**Percent %**	**(No.)**	**%**
Present	94	37.9	21	(22.3)
Absent	154	62.1	-	-
TYPES OF CALCIFICATION				
Skin	16	17.0	-	-
Worm-like	4	4.3	-	-
Coarse	15	16.0	-	-
Popcorn	6	6.4	6	(28.6)
Milk	5	5.3	-	-
Rim	4	4.3	4	(19.0)
Vascular	19	20.2	-	-
Rod – Like	8	8.5	1	(4.8)
Micro calcification	12	12.8	7	(33.3)
Widespread, pleomorphic	5	5.3	3	(14.3)
Total	**248**	**100.0**	**21**	**100.0**

Table V: Distribution of calcification

Location	**Frequency (No.)**	**Percent %**
Upper Outer Quadrant	9	9.6
Upper Inner Quadrant	13	13.8
Lower Outer Quadrant	20	21.3
Lower Inner Quadrant	20	21.3
Around Nipple	32	34.0
Total	**94**	**100.0**

Table V1: Mammographic, Ultrasonic Versus Histological Diagnosis

Mammographic Diagnosis (No.) %	**Ultrasound Confirmed (No.) %**	**Histology Confirmed (No.) %**	**Not Confirmed No. %**
No abnormality 137 (55.2)	- -	- -	- -
Abnormality 111 (44.8)	45	29	37
Types of Abnormalities			
Abscess 9 (3.6)	9 (100)	- -	- -
Fibroadenoma 29 (11.7)	19 (65.5)	6 (20.7)	4 (13.8)
Fibrocystic Disease 15 (6.4)	11 (73.3)	4 (26.7)	- -
Carcinoma 23 (9.3)	3 (13.0)	14 (60.9)	6 (26.1)
Colloid Carcinoma 4 (1.6)	- -	1 (25.0)	3 (75.0)
Dilated ducts 3 (1.2)	3 (100)	- -	- -
Lymph nodes 28 **(**11.3)	- -	4 (14.3)	24 (85.7)

X^2 = 77.1, DF = 12, P = 0.00

LEGEND TO FIGURE

Figure 1 Cup like milk calcification in the lower outer quadrant of the right behind the nipple and a popcorn calcification in the lower inner quadrant of the same breast

Figure 2 Large popcorn calcification in the upper outer quadrant without a coexisting mass

Figure 3 Branching rod–like calcifications in the lower outer quadrant of the breast close to the nipple

Figure 4 Large, well defined, irregularly outlined, lobulated mass with widespread microcalcifications

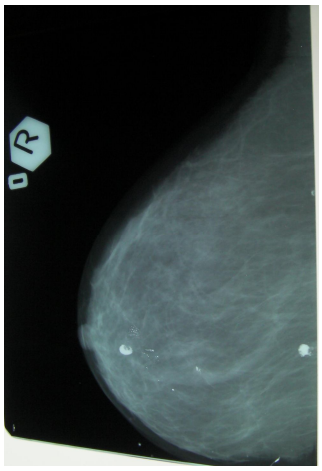

Figure 1

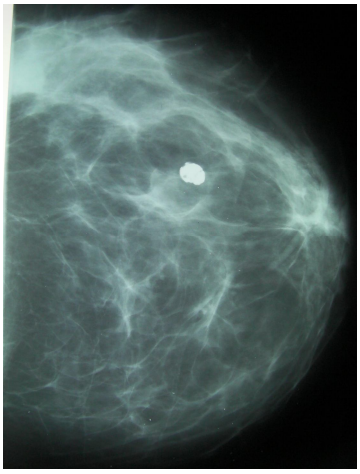

Figure 2

Figure 3

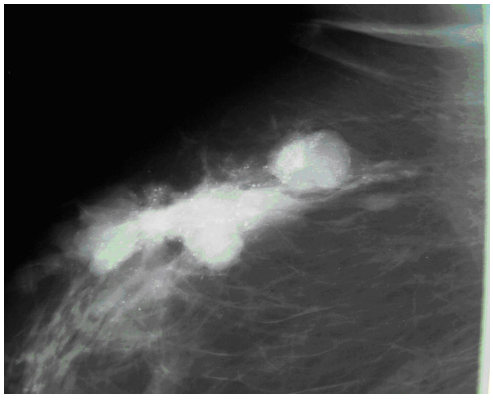

Figure 4