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The Radiologist at the Center of Breast Conservation in the Management of Breast Cancer: A Case-Based Narrative Review of the Literature

Review Article

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Author Details

*Adeleye Dorcas Omisore**

Department of Radiology, Obafemi Awolowo University, Nigeria

*Corresponding author

Adeleye Dorcas Omisore, Department of Radiology, Obafemi Awolowo University, Nigeria

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Abstract

The management of breast cancer involves a multidisciplinary team approach involving the surgeon, radiologist, pathologist, radiotherapist, and clinical oncologist. Radiology in the management of breast cancer patients allows for lesion detection and characterization, confirmation of diagnosis with image-guided biopsy, post-biopsy placement of clip marker, confirmation of patients' eligibility for breast conservation surgery, image-guided localization, staging, evaluation of response to therapy before surgery, and follow-up after treatment for breast cancer. This narrative review is based on a case of a 35-year-old woman offered breast-conserving therapy for stage IIB breast cancer in a tertiary hospital in Southwest Nigeria. This case-based review highlights the radiologist's vital role in breast conservation in the management of breast cancer, elaborating on the radiological management of this patient.

Keywords: Radiologist; Role; Breast conservation

Introduction

Breast cancer remains the commonest type of cancer in women, with an alarmingly increasing incidence in developed and developing countries [1-3]. Radiology is an integral part of the Multidisciplinary Team (MDT) approach to breast cancer management [4]. Other members (surgeon, pathologist, radiation, medical and surgical oncologists) of the breast MDT rely on the radiologist for imaging information they require to diagnose breast cancer and develop a treatment plan for the breast cancer patient [5]. The treatment plan usually involves a combination of surgery (mastectomy vs. lumpectomy/breast-conserving surgery/partial mastectomy), radiation, hormone therapy, chemotherapy, and targeted therapies depending on the cancer stage, tumor characteristics, menopausal status, and age of the patient [6]. Breast-Conserving Surgery (BCS) is now offered to early-stage breast cancer patients with proven similar survival rates as mastectomy and better cosmetic results [7-10]. However, anecdotal data from nationwide audits show meager use of BCS in Nigeria. Few breast surgeons currently offer BCS to eligible patients to keep pace with global oncologic treatment recommendations. The radiologist plays a pivotal role in this process. This article reviews available literature on the radiologist's role in breast-conserving therapy.

Case Presentation

A 35-year-old premenopausal para 2 woman, after a left lumpectomy and a histopathology report of invasive ductal carcinoma from a private hospital, presented to this tertiary hospital for specialist care and evaluation. Upon examination, the general surgeons did not detect any palpable abnormality in her breasts but did find palpable lymph nodes in her left axillary region. She was subsequently referred for breast ultrasound and breast Magnetic Resonance Imaging (MRI) to

rule out residual disease and thoraco-abdominopelvic Computerized Tomography (CT) scan for staging purposes. Ultrasound examination of the breasts revealed post-operative changes in the lower inner quadrant of the left breast without evidence of associated mass and enlarged, rounded left axillary lymph nodes with loss of hilar fat (Figure 1). The thoraco-abdominopelvic CT scan showed these enlarged left axillary nodes but otherwise normal findings in the right axilla, bones, chest, abdomen, and pelvis (Figure 1) The breast MRI revealed bilateral axillary nodes (Left worse than right) that showed restricted diffusion on diffusion-weighted imaging sequence and post-surgical changes in the lower inner quadrant of the left breast (Figure 1). Based on overall imaging findings, the patient was classified as a stage IIB (T2 N1 MO) cancer. Ultrasound-guided core biopsy of the most suspicious node of the left axillary nodes was done without clip placement (Figure 2). However, a hydromark clip marker was also placed in the surgical bed within the left breast under ultrasound guidance. Unfortunately, a post-clip placement mammography was not done on the patient to confirm clip placement. The histopathology revealed clusters of malignant epithelial cells within the lymphoid tissue which is consistent with metastatic carcinoma. As a result, the patient was offered neoadjuvant chemotherapy (NAC) and scheduled for BCS after six cycles of chemotherapy.

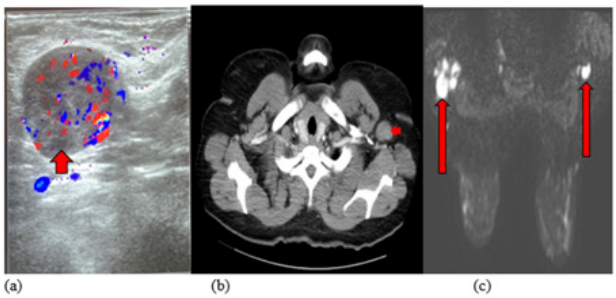

Figure 1: Ultrasound (a), axial CT (b) and axial MRI images showing the enlarged left axillary lymph nodes which show vascular flow and are rounded on USS (short arrow) and CT (arrowhead) and show restricted diffusion on MRI (long arrow).

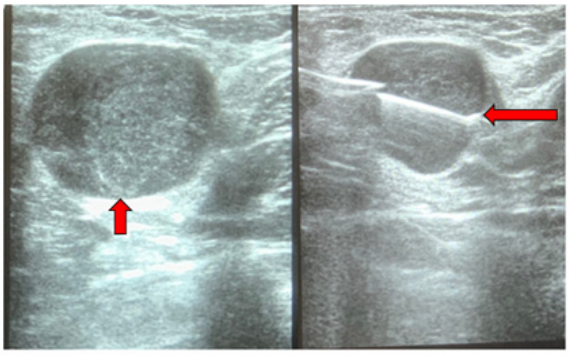

Figure 2: B mode ultrasound of the left axillary lymph node (short arrow) with core biopsy needle (long arrow) seen within it.

Mammography done following the six cycles of NAC revealed pleomorphic microcalcifications in segmental distribution in the lower inner quadrant of the left breast, posterior to the hydromark clip marker placed in that quadrant (Figure 3). Pre-operative Wire Localization (WL) was scheduled for the morning of the surgery to mark the microcalcifications and clip marker. The microcalcifications and clip marker were bracketed with two Kopan wires in the radiology department under ultrasound guidance on the morning of surgery (Figure 4). After excision by the surgeons, specimen radiography was done in the radiology department's mammography suite, which showed the pleomorphic microcalcifications, the clip marker, and one of the Kopan wires within the specimen (Figure 4). Histopathology revealed a good response to NAC with no residual invasive disease and treatment effects in the lumpectomy specimen. However, there were metastatic tumour deposits within the lymph nodes (N1a). In addition, ductal carcinoma in situ was identified in the specimen associated with the microcalcifications with negative margins. Follow-up mammography was done six weeks after the BCS, which showed three surgical clips left at the surgical site by the surgeons to guide adjuvant radiation therapy. However, the previously described calcifications and the clip marker in the lower inner quadrant of the left breast were not visualized (Figure 5). The patient is currently on adjuvant radiotherapy.

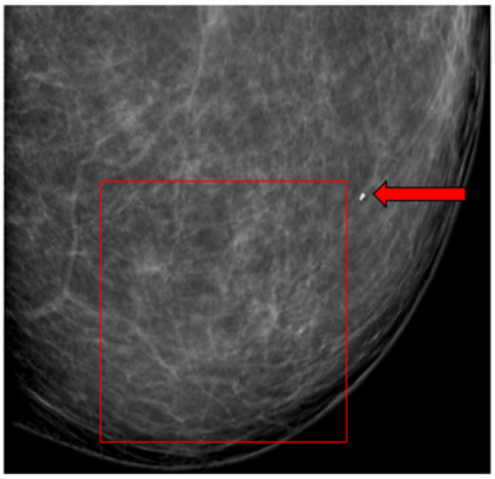

Figure 3: Digital magnification image of Post-NAC mammogram showing the segmental microcalcifications (box) and clip marker (arrow).

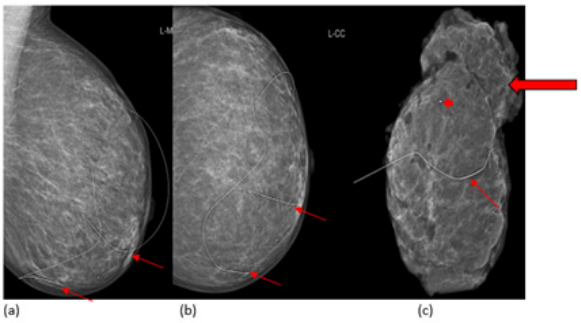

Figure 4: Post-WL mammograms: Medio-lateral oblique (a) and craniocaudal views (b) showing the wires used to bracket the clip and macrocalcifications (thin arrows). The specimen radiograph (c) showing the microcalcifications (thick arrow), clip marker (arrowhead) and one of the Kopan wires (thin arrow) used for bracketing.

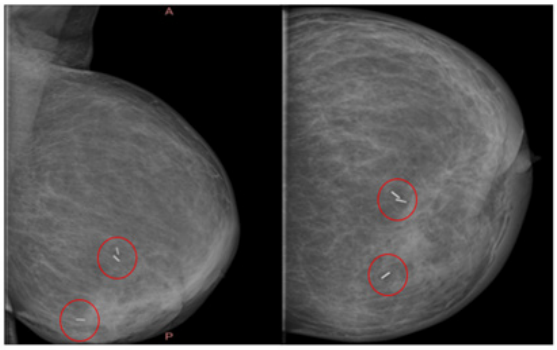

Figure 5: Post-BCS mammograms (MLO and CC views) showing 3 surgical clips (circles) left in the surgical site by the surgeon and post-surgical changes in the breast. No remnant microcalcification or clip marker in the breast.

Discussion

Radiologists play an essential role in breast cancer screening, diagnosis, treatment planning, and initiation, as well as long-term follow-up [11]. By providing screening for asymptomatic women and diagnostic evaluation for symptomatic women, the radiologist represents the entry point into the breast cancer treatment pathway [11]. Specific roles of the radiologists in BCS include characterization of breast abnormalities, determination of the suitability of patients for BCS based on the extent of imaging abnormality, obtaining biopsy specimens for histopathology appraisal, post-biopsy placement of clip markers to guide correlation between modalities and later lesion localization, localization of non-palpable lesions, staging, evaluation of response to therapy prior to surgery and follow-up of the patients after treatment [12,13].

Characterization of breast abnormality

Breast cancer can be palpable or non-palpable [14] and can present as a mass, an asymmetry, microcalcification, or architectural distortion on imaging [15,16]. Palpable lesions are usually detected on Self-Breast Examination (SBE) by the patient or on Clinical Breast Examination(CBE) by a health care provider. In contrast, non-palpable lesions are not noticed on SBE and CBE but are detected on imaging [14]. For palpable breast lesions, the radiologist's role is to characterize the lesions based [11,12] on the imaging findings in accordance with BI-RADS criteria [17,18]. These characteristics include their margins, shape, appearance (i.e., echogenicity on ultrasound, density on mammography, or intensity on MRI), and associated features like microcalcifications and architectural distortion [17-21]. In contrast, non-palpable lesions are detected on imaging and require the radiologist to localize and characterize them based on their imaging features. In the index case, the radiologist characterized the CBE-palpable axillary nodes as suspicious for malignancy based on their rounded shape, hypoechoic appearance, and loss of hilar fat on ultrasound and MRI [17,20,21].

Determination of suitability of patients for BCS

In determining the suitability of patients for BCS, the radiologist needs to provide information on the multiplicity of lesions [22,23]. Lesions can be multifocal (multiple lesions in the same quadrant of the breast or less than 5cm apart) or multicentric (multiple lesions in different quadrants of the breast or greater than 5cm apart) [22-24]. Identifying patients with multicentric lesions who may not be eligible for BCS [7-9] is vital. For the reference case, the breast ultrasound and MRI done in our hospital did not identify any residual disease; however, the mammogram obtained post NAC identified residual suspicious calcifications. The post-surgical changes in the lower inner quadrant of the left breast confirmed the location of the initial lump removed. The microcalcifications identified on the post-NAC mammograms were also located in the same quadrant as the post-surgical changes without abnormality in other quadrants, excluding multicentric disease and confirming the eligibility of this patient for BCS.

Localization of non-palpable lesions

Non-palpable lesions are usually detected through screening studies [14]. In such cases, the radiologist identifies the location of the lesion [11,12] in addition to characterizing it, as seen in the index case where non-palpable suspicious microcalcifications were identified in the lower inner quadrant of the left breast on post-NAC mammography. In patients eligible for BCS [7,8], as in the index case, a radiologist is responsible for marking the exact location of the screen-detected non-palpable lesions to aid accurate excision by the surgeons. Wire Localization (WL), also called fine-wire, wire-guided, or needle localization, is an accurate technique for marking mammographically detected breast abnormalities [25-29] (Figure 4). Wire localization is widely accepted as a standard technique for pre-operative image-guided lesion localization in patients with non-palpable early-stage breast cancer eligible for BCS [27,28]. Therefore, WL was done for the non-palpable microcalcifications identified on her post-NAC mammograms by the Attending Radiologist (ADO). While MRI is usually the imaging modality of choice to monitor response to neoadjuvant therapy [30], mammography or ultrasound guidance is usually preferred for WL [27]. Extensive lesions and calcifications, especially those that exceed the borders of a mass, frequently require mammographic guidance and multiple wires for bracketing [27,31,32].

The targeted lesions, in this case, were microcalcifications, making mammography the most appropriate modality for WL. Unfortunately, the mammography machine in our hospital does not have the facility for WL and stereotactic biopsy. The WL was therefore done under ultrasound guidance using the location of the sonographically visible clip marker and target lesions (microcalcifications) on mammography as landmarks. In this case, the clip marker and calcifications were bracketed from the anterior and medial borders with two Kopan wires to ensure complete excision of the tumour bed, including any visible calcifications, which is the standard of practice [27]. The clip marker and microcalcifications were bracketed from the anterior and medial borders, with post-localization mammography serving as a guide for the relationship of the wires to the area targeted for excision. Specimen radiography is required after excisions to identify that the target has been excised and that what was used for localization was removed and not fragmented. In this reference case, the clip and microcalcifications but only one of the wires were visualized in the specimen radiograph. The unavailability of localization paddles for the mammography unit in our hospital was a limitation to mammography-guided WL in this reference case. Other potential challenges of having a localization program in Nigeria include limited availability of localization wires, technologists/radiographers experienced with assisting with the procedure and experienced radiologists.

Obtaining biopsy specimen for histopathology appraisal

Biopsy of breast lesions is necessary to obtain tissue for histopathological appraisal of the breast lesion [14,15]. Image-guided biopsy by the radiologist is more accurate than blind palpation-guided biopsies by surgeons [33], with fewer attending complications [33-35]. Image guidance for biopsy can be done using ultrasound, mammography, or MRI, depending on the modality in which the lesion was seen and the availability of biopsy equipment and trained radiologists [33]. The axillary nodes were detected on CBE and confirmed on ultrasound and MRI in the index case. However, ultrasound, the only modality feasible for biopsy in our hospital, was used by the radiologist to guide the nodes' core-needle biopsy, which yielded good histopathological cores.

Post-biopsy placement of clip marker in breast lesions

Clip markers are usually placed in the biopsy cavity by the radiologist after image-guided biopsies of breast lesions to aid tumour localization in patients going for NAC and BCS [36,37]. The fate of these clips depends on the histopathological diagnosis of the lesion. When the histopathological diagnosis of the biopsied lesion is benign, the clips are left with the lesion. When the histopathological diagnosis of the biopsied lesion is malignant, the clips are removed along with the lesion during surgery. Clip markers are composed mainly of titanium and are harmless when left with a benign lesion in the patient [37]. Even though there was no obvious mass in the breast on ultrasound when the reference case presented to our hospital, a clip marker was placed in the lumpectomy site at the time of the core needle biopsy of the left axillary nodes by the attending radiologist at the request of the managing surgeon to ensure lumpectomy site could be located after NAC. Clip markers are easily visualized on mammography and ultrasound; however, they cause susceptibility artifacts on MRI [38], the gold standard for assessing tumor response on imaging [39]. There is limited availability of clips in Low-Middle-Income Countries (LMICs) which is a potential challenge to later lesion localization/BCS in Nigeria.

Staging

The stage of the disease determines breast cancer treatment options [6]. The radiologist plays a vital role in staging breast cancer patients [12]. Imaging modalities used in staging include chest x-ray, lumbosacral spine x-ray, abdominopelvic ultrasounds, thoraco-abdominopelvic CT, and brain MRI [40-42]. The imaging modalities are tailored toward the patient's metastatic symptoms or are based on the standard institutional protocol. In our hospital, the standard protocol for staging includes a chest x-ray, abdominopelvic ultrasound, and thoraco-abdominopelvic CT scan. The index patient had a thoraco-abdominopelvic CT scan which was essentially unremarkable except for the enlarged morphologically abnormal left axillary nodes seen. The American Joint Committee on Cancer (AJCC)'s TNM classification is used to guide staging for breast cancer [43]. The TNM stage of the index case was IIB (T2 N1 M0) since it was limited to the breast and axillary lymph nodes.

Breast-Conserving Surgery (BCS) with adjuvant radiotherapy with or without chemotherapy is now recommended for patients with breast cancer limited to the breast and axillae [44]. The index patient was offered NAC, BCS, and adjuvant radiotherapy.

Evaluation of response to NAC

Neoadjuvant Chemotherapy (NAC) is important in the treatment of both operable and non-operable breast cancers. Neoadjuvant Chemotherapy (NAC) can help improve surgical outcomes, reduce complications, and improve cosmetic outcomes [36]. Breast cancer patients like this reference case who are offered NAC are evaluated by the radiologist before surgery [11,12] to determine their response to therapy [45]. Response to therapy is usually categorized as complete, partial, no response (stable disease), or progressive disease [44]. The Response Evaluation Criteria in Solid Tumors (RECIST) criteria [45] is one tool that allows for this categorization. Histopathology provides the gold standard for this categorization [46]. However, pre-NAC imaging is needed for comparison with post-therapy imaging. Unfortunately, the index patient did not have pre-therapy mammography to compare with the post-therapy mammography. The mammographically-detected microcalcifications on her post-NAC mammograms, which were not visible on the initial breast ultrasound and MRI, may have been present with the initial lump or developed during treatment. Therefore, the response category of this patient could not be ascertained by imaging. However, histopathology of the breast specimen from BCS showed a good response to NAC with no residual invasive disease. However, three of the 19 lymph nodes harvested at surgery showed residual disease.

Follow-up of patients after treatment for breast cancer

The radiologist's role does not end with treatment [47]. Post treatment for breast cancer, the patients are usually followed up for years by the radiologist with annual mammography of both breasts (after BCS) or the contralateral breast (after mastectomy) as a personal history of breast cancer increases the average risk of the contralateral breast for cancer [47,48]. The standard protocol in the breast unit of the radiology department in our institution is to offer complementary ultrasound of the chest wall of the mastectomy site and the ipsilateral axilla in addition to screening mammography of the contralateral breast in order to detect any recurrence that is yet to be clinically apparent. Patients who get BCS have post-lumpectomy mammography done to ensure that all suspicious calcifications have been excised prior to beginning radiation therapy. Post-treatment mammography is also recommended 1 year after the initial mammography and 6 months after completion of adjuvant radiation therapy in patients who have BCS, which is the plan for the index case.

Conclusion

This article highlights the crucial role of the radiologist in breast conservation in the management of breast cancer. The case presented serves as a wake-up call for Nigerian radiologists to align their breast imaging practice and research objectives with multidisciplinary stakeholders in breast cancer management toward achieving breast-conserving therapy in Nigeria.

Conflict of Interest

The author declares no conflict of interest.

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