

Revisiting the Imaging Features of Breast Pathologies: A Guide for Budding Radiologists

JYOTI GUPTA¹, RENU YADAV²

ABSTRACT

Breasts undergo continuous physiological changes throughout the different phases of the female life cycle-menstrual cycle, pregnancy, lactation, and postmenopause- making them prone to a variety of masses ranging from Aberrations of Normal Development (ANDI) to inflammatory breast carcinoma. This pictorial review aims to present the imaging features of the most frequently encountered breast lesions: fibroadenoma, ANDI, intramammary lymph node, infectious tubercular mastitis, phyllodes tumour, post-breast conservation surgery changes, and breast carcinoma. Sonomammography remains the cornerstone for the diagnosis of the majority of lesions. Mammographic and ultrasound reporting is facilitated by the Breast Imaging Reporting and Data System (BIRADS) provided by the American College of Radiology (ACR). Magnetic Resonance Imaging (MRI) plays a vital role in differentiating scar from tumour recurrence, assessing treatment response, and serving as a problem-solving modality.

Keywords: Breast imaging, Fibroadenoma, Phyllodes tumour, Sonomammography

INTRODUCTION

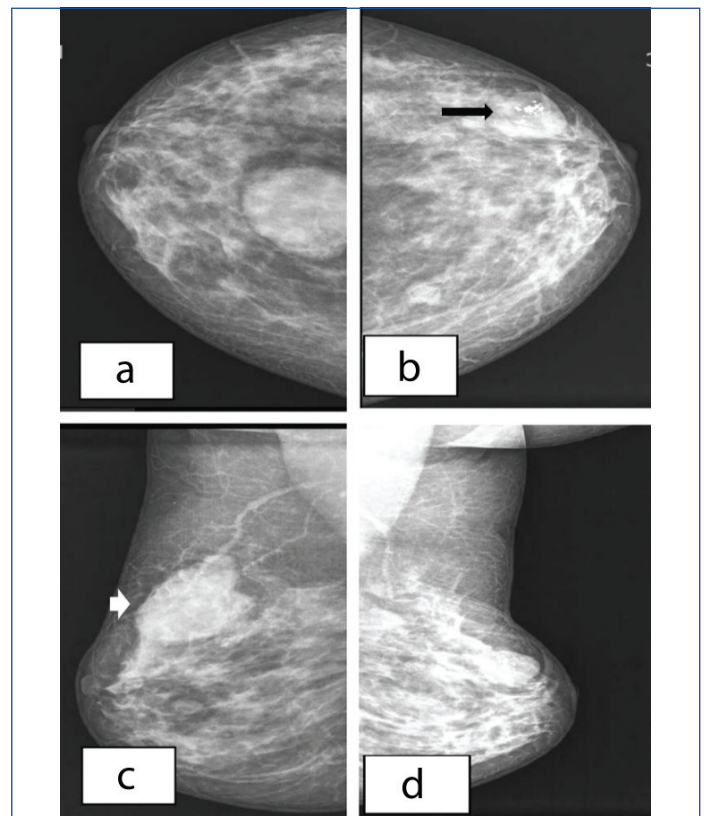
The breasts, or mammary glands, are superficial apocrine glands located in the prepectoral region, extending toward the axillary tail in females, with the added function of milk production. They undergo continuous physiological changes throughout the menstrual cycle, beginning with thelarche during adolescence and continuing till involution and fibroglandular atrophy in the postmenopausal period. These dynamic changes, along with the variable admixture of fibroglandular and fibrofatty tissue, result in a wide range of imaging appearances of normal breast parenchyma [1].

Available imaging modalities include sonomammography, Digital Breast Tomosynthesis (DBT), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) with or without contrast administration. Sonomammography is the initial imaging investigation for diagnosis [2]. Multiparametric breast MRI has high sensitivity and serves as a helpful adjunct to sonomammography in challenging cases or in dense breasts, though its specificity is relatively low [3]. In DBT, the X-ray machine moves in an arc, acquiring images at different depths, which enables differentiation of true masses from summation shadows; however, increased radiation dose is a concern [4]. CT has limited utility in characterising breast lesions but plays a vital role in staging malignant masses. This review discusses the radiological findings of some of the most commonly encountered female breast lesions and their initial management in routine clinical practice.

Imaging Findings in Various Pathologies

Fibroadenoma: Typical fibroadenomas are benign, mobile breast lesions arising from the lobular stroma of the Terminal Ductal-lobular Unit (TDLU), with a mean age of presentation between 18 and 40 years. These hormonally responsive tumours may change in size during pregnancy, lactation, or menopause [5]. On mammography [Table/Fig-1], they appear as round to oval, well-circumscribed, isodense masses and may show fewer than four lobulations. Coarse, clustered calcifications can be seen in involuting fibroadenomas in postmenopausal women and are pathognomonic of fibroadenoma. On ultrasound [Table/Fig-2], a typical fibroadenoma appears as an oval, well-circumscribed, wider-than-tall hypoechoic lesion with parallel orientation, mild posterior acoustic enhancement, and edge shadowing. Classical patterns of homogeneous enhancement with

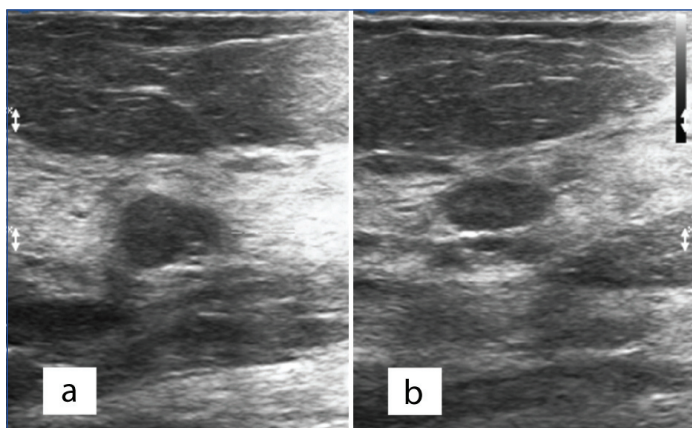
hypointense septae are described on dynamic contrast imaging as Type I curves [6].



[Table/Fig-1]: Mammographic images of bilateral breasts in cranio-caudal CC (a,b) and mediolateral oblique views MLO (c,d) show well-defined round to oval isodense lesions in bilateral breast parenchyma. No evidence of any surrounding architectural distortion with normal overlying skin, subcutaneous tissue, and underlying pectoralis major muscle. Lesion in left upper outer quadrant shows macro-lobulated margin (solid white arrow), likely fibroadenoma. In contrast, one of the lesions in the right breast in the upper outer quadrant shows coarse macro-calcification (solid black arrow)- likely an involuting fibroadenoma.

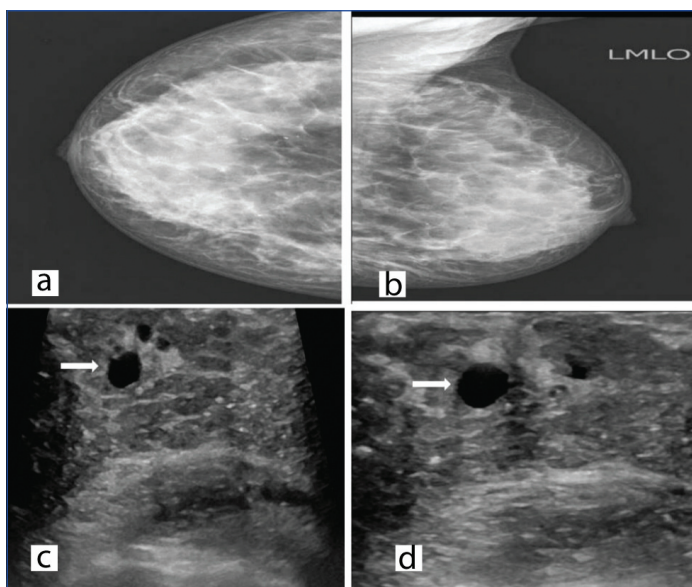
First-time diagnosed fibroadenomas in young patients can be followed-up after one year to confirm lesion stability. Involved fibroadenomas do not require follow-up. Lesions with atypical features- such as being taller than wide, having more than four

lobulations, or heterogeneous imaging appearance- require histopathological examination [5].



[Table/Fig-2]: Ultrasound images showing typical sonographic features of fibroadenoma, a well-circumscribed oval lesion wider than taller, hypoechoic, with parallel orientation, mild posterior acoustic enhancement, and edge shadowing.

Fibroadenosis: ANDI mainly affects premenopausal women aged 20 to 50 years, presenting with painful, ill-defined lumps in both breasts. Mammography often demonstrates dense breast parenchyma, which can make it difficult to appreciate changes such as cysts or scar tissue. Some cases may show asymmetrical densities or focal architectural distortions [Table/Fig-3]. On ultrasound, areas of increased parenchymal thickness are seen with a predominant fibroglandular component and altered echogenicity. Multiple simple or complicated cysts of variable sizes may be present throughout the parenchyma. Usually, no follow-up or additional imaging is required. Contrast-enhanced MRI (CEMRI) often shows non mass-like enhancement in most cases, typically with a Type I curve [7].



[Table/Fig-3]: Mammographic craniocaudal and mediolateral oblique images (a,b) show heterogeneously dense glandular parenchyma ACR-C. Multiple scattered microcalcific foci are seen in the upper outer quadrant. Correlated Ultrasonographic (c and d) images show thickened echogenic breast parenchyma with multiple variable-sized simple cysts within parenchyma, suggestive of diffuse fibroadenosis (solid white arrow).

Intramammary lymph node: Intramammary lymph nodes are benign findings, most commonly seen in the upper outer quadrant of either breast. On mammography, they appear as oval, well-defined, isodense lesions with an eccentric lucency, typically located adjacent to a vessel [Table/Fig-4] [8]. On ultrasound, they appear as discrete, well-circumscribed, reniform oval hypoechoic lesions with an eccentric fatty hilum. Changes in shape or density on follow-up examinations may warrant further evaluation, such as fine needle aspiration cytology.

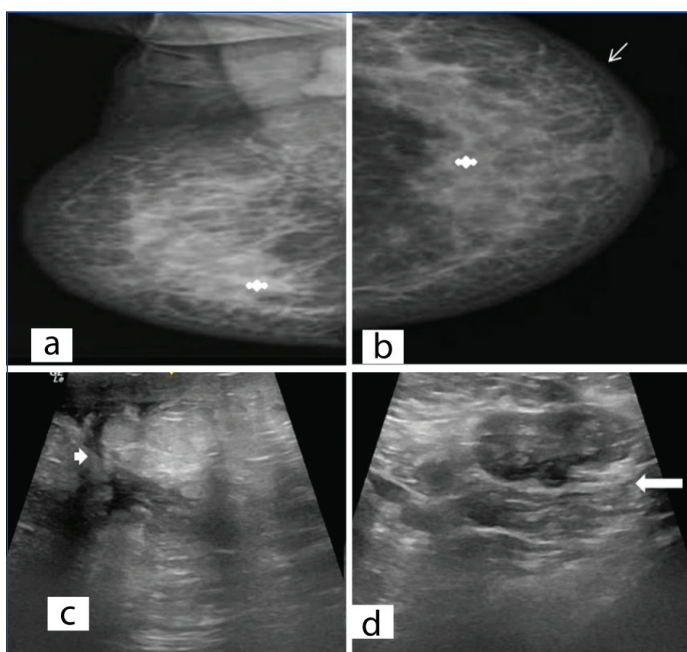
Infectious tubercular mastitis: Mastitis is a common clinical finding, most frequently occurring during lactation and sometimes

resulting in abscess formation. Isolated breast tuberculosis is rare, even in regions with high disease prevalence [9]. There are three distinct types of presentation: nodular, diffuse, and sclerosing, each of which can closely mimic breast carcinoma on both clinical and imaging evaluation. The nodular form presents as a hyperdense, round lesion with indistinct margins on mammography. The diffuse form shows multiple intercommunicating caseating granulomas throughout the parenchyma, which may result in ulceration or a discharging sinus. Mammography may demonstrate focal architectural distortion, dense parenchyma, and skin thickening. The sclerosing form is dominated by fibrosis, resulting in hard breast parenchyma and nipple retraction. On mammography, it may appear as areas of increased density with irregular margins.

On ultrasound, tuberculous mastitis presents as heterogeneous parenchymal echotexture, with or without a definitive focal lesion. It may also be associated with significant axillary lymphadenopathy, which can show microcalcifications, and in some cases, concurrent pulmonary involvement, as seen in [Table/Fig-5]. A biopsy of the lesion is necessary to establish the diagnosis [10,11].



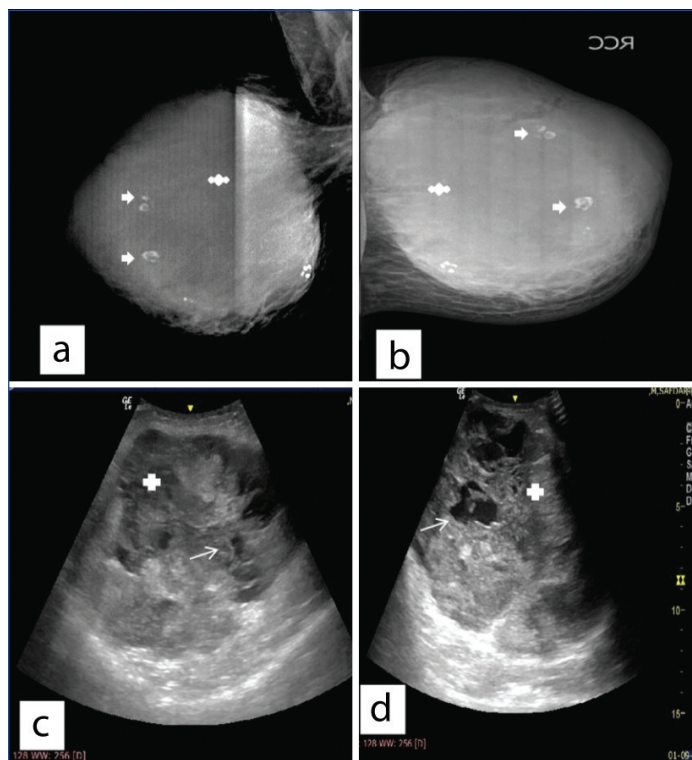
[Table/Fig-4]: Ultrasound images show intramammary lymph nodes with peripheral cortex and eccentric echogenic hilum (star).



[Table/Fig-5]: Mammographic images (a and b) shows diffuse increase in glandular parenchymal density (quad arrow), trabecular thickening along with mild thickening of overlying skin subcutaneous tissue (white arrow) and axillary lymph node. Correlated Ultrasonographic image of breast (c) show heterogenous parenchymal echotexture without any definitive focal lesion (short solid white arrow). Ipsilateral axilla (d) shows enlarged lymph node (solid white arrow) with microcalcification and necrosis within. FNAC from axillary lymph node depicted caseating granuloma suggestive of tuberculosis.

Paget's disease: Paget's disease presents with erythema, ulceration, eczematous changes, and induration of the nipple-areolar complex and may be associated with nipple retraction or blood-stained nipple discharge. Underlying Ductal Carcinoma In Situ (DCIS) or invasive breast cancer is present in 80-90% of patients [12]. On mammography, diagnostic findings include nipple-areolar skin thickening, asymmetric density, and nipple retraction [12]. A mass, if present, may be located in a subareolar region or distant from the nipple-areolar complex. Other findings, such as pleomorphic calcifications, may or may not be associated with skin thickening or architectural distortion. Asymmetrical thickening and enhancement of the nipple-areolar complex, an underlying mass, and segmental or regional non mass-like enhancement with Type II or III curves- or a combination of these findings- may be seen [13]. A guided biopsy of the underlying lesion determines the patient's clinical management.

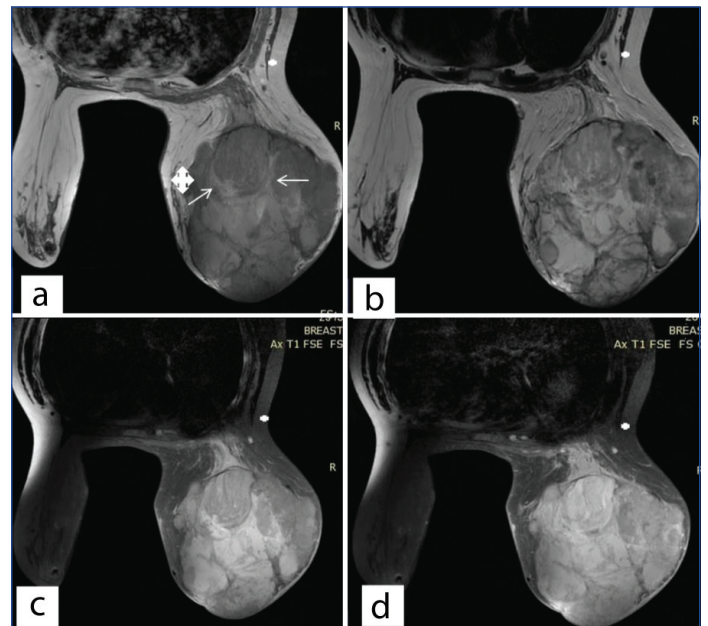
Phyllodes tumour: Phyllodes tumours are rare neoplasms that share histopathological, clinical, and radiological similarities with fibroadenomas [14]. They are typically ≥ 3 cm in size and demonstrate irregular shape, microlobulated borders, complex internal echo patterns, hypervascularity, and internal cystic areas [Table/Fig-6,7]. The clinical course of phyllodes tumours varies according to histological classification: benign, borderline, or malignant. On imaging, differentiation among classes is challenging; borderline and malignant tumours are usually >7 cm and appear as irregular masses with non circumscribed margins [15]. Biopsy is recommended in all suspicious cases.



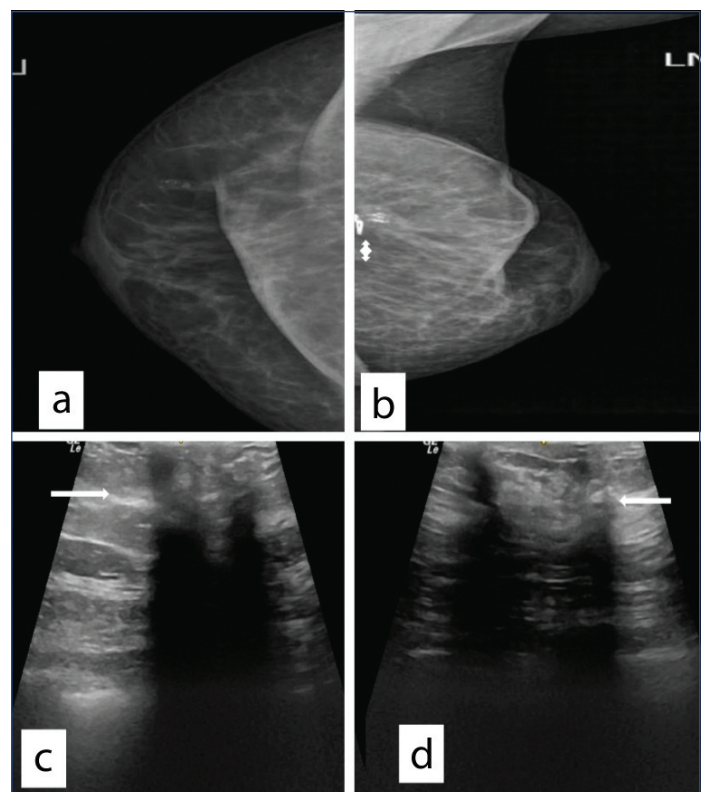
[Table/Fig-6]: Mammographic images (a,b) show extremely dense breast with large well defined mass completely replacing the parenchyma (quad arrow). Multiple scattered clustered coarse calcific foci seen within the parenchyma (solid white arrow). Correlated Ultrasonographic (c,d) images show a large well well-circumscribed solid mass (plus) with cleft-like internal cystic spaces (arrow) suggestive of phyllodes tumour. No evidence of any infiltration into surrounding tissues or significant axillary lymphadenopathy.

Post-breast conservation surgery: Early detection of breast lesions allows for treatment with breast conservation surgery. Therefore, practicing radiologists must be aware of normal postoperative changes and recognise suspicious findings that guide further management. Postoperative mammography may show architectural distortion with metallic clips [Table/Fig-8]. Other findings may include skin thickening or oedema, parenchymal oedema, postoperative fluid collections, scars, fat necrosis, and dystrophic calcifications

[16]. Red-flag signs necessitating further multimodality investigation include parenchymal neodensity, scar enlargement, asymmetry, microcalcifications, increased skin thickening, nipple calcification, or axillary nodal recurrence [17].



[Table/Fig-7]: CEMRI breast images shows a large well-defined solid lesion with lobulated margins (quad arrow) and internal cystic areas (thin white arrow) replacing whole of the right breast parenchyma which appears isointense on T1WI, mildly hyperintense on T2WI and shows heterogeneous post-contrast enhancement (d)- consistent with phyllodes tumour. No evidence of any ipsilateral significant lymphadenopathy (plus) Left breast parenchyma is normal.

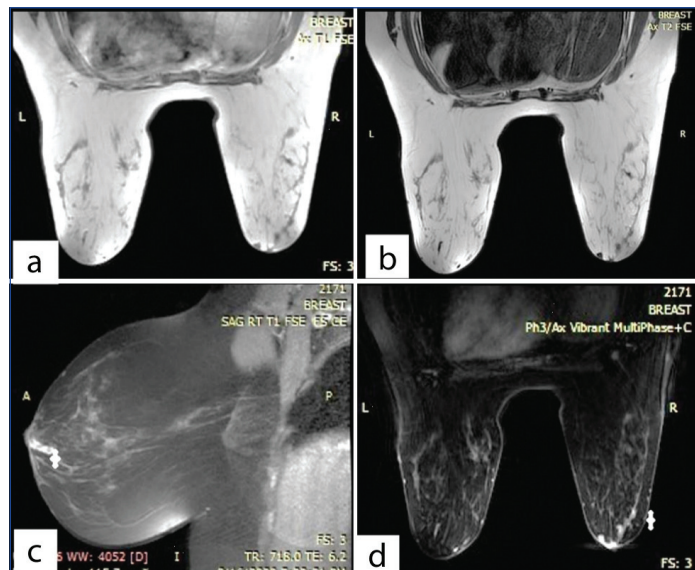


[Table/Fig-8]: Mammographic images (a,b) show postoperative architectural distortion with metallic clips in upper outer quadrant (quad arrow). Correlated ultrasound (c,d) images show scar tissue with posterior acoustic shadowing (solid white arrow). No solid nodule/seroma seen.

Intraductal papilloma: Intraductal papillary lesions can be classified as solitary intraductal papillomas, multiple intraductal papillomas, papillomas with atypia or DCIS, micropapillary DCIS, and papillary carcinoma [18]. Solitary intraductal papillomas are usually retroareolar and commonly present with unilateral bloody nipple discharge, whereas multiple intraductal papillomas arise in TDLU, present as palpable masses, and are more frequently associated with atypia,

DCIS, or malignancy [19]. Papillomas with atypia or DCIS cannot be distinguished from simple papillomas on imaging.

On mammography, small papillomas are often occult, while larger lesions appear as round or oval isodense masses with well-circumscribed margins. On galactography, these lesions appear as smooth, mural-based filling defects. Care must be taken when interpreting scans, as air bubbles can mimic these radiological features. On ultrasound, well-defined or ill-defined iso- to hypoechoic mural nodules with vascularity are seen within dilated ducts. Inspissated secretions within dilated ducts can also appear as masses but do not show vascularity. In challenging cases, MRI can confirm the presence of small intraductal papillomas as enhancing lesions within dilated ducts [Table/Fig-9]. Larger papillomas appear as enhancing nodules, with or without intraductal components. Dynamic contrast-enhanced MRI may show Type II or III curves [20].

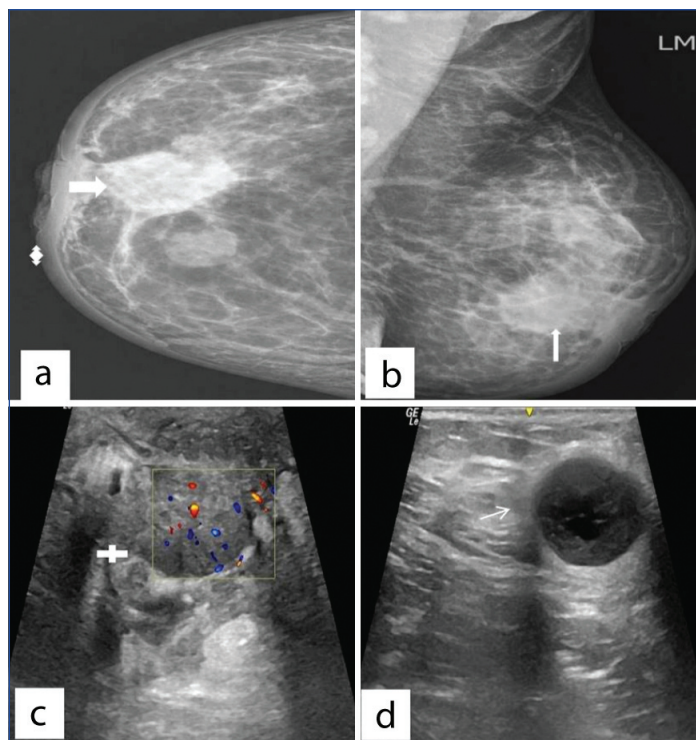


[Table/Fig-9]: MRI breast images of patient with unilateral bloody nipple discharge shows a solitary dilated duct in left breast in lower outer quadrant which appears isointense on T1/T2 images (a and b), show diffusion restriction (quad arrow) on DWI images and show early enhancement on dynamic MRI images (c). Subtraction MRI images (d) show solitary dilated enhancing duct (quad arrow) consistent with ductal papilloma.

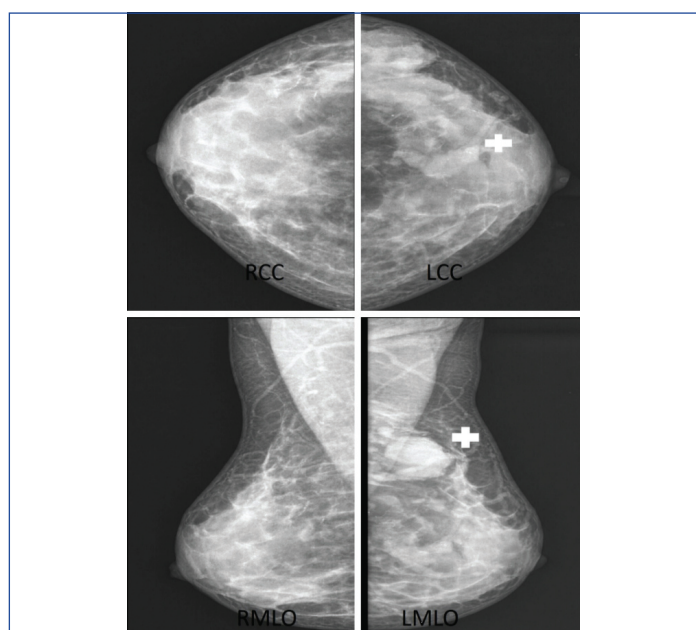
Breast carcinoma: Breast cancer has now become the most commonly detected cancer in India, with an alarming increase in incidence among young females. On mammography [Table/Fig-10,11], malignant masses usually appear as irregular, high-density lesions with microlobulated or spiculated margins. Ancillary findings may include surrounding architectural distortion, overlying skin or subcutaneous thickening, suspicious calcifications, or axillary lymphadenopathy.

On ultrasound [10,12], most malignant lesions appear as irregular, heterogeneous masses with spiculated margins, anti-parallel orientation, satellite nodules, and posterior acoustic shadowing [Table/Fig-12]. Some lesions may present as complex solid-cystic masses or benign-appearing, well-circumscribed hypoechoic masses.

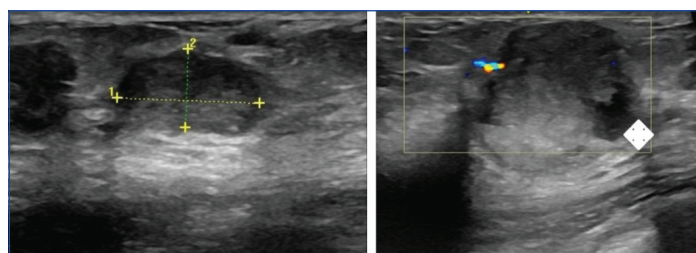
Multiparametric breast MRI [Table/Fig-13] is primarily used for loco-regional staging of suspicious lesions, characterisation of indeterminate lesions, detection of occult breast carcinoma in patients with metastatic axillary lymphadenopathy, evaluation of recurrent breast cancer after breast-conserving therapy, differentiation between scar tissue and recurrent tumour, and assessment of multifocality in known cases of breast cancer [21]. Features suggestive of malignancy on MRI include irregular or spiculated masses with central enhancement, enhancing septae, and ductal or segmental distribution of non mass-like enhancement. Both Type II (6-29%) and Type III (29-77%) enhancement curves may be observed in malignant lesions.



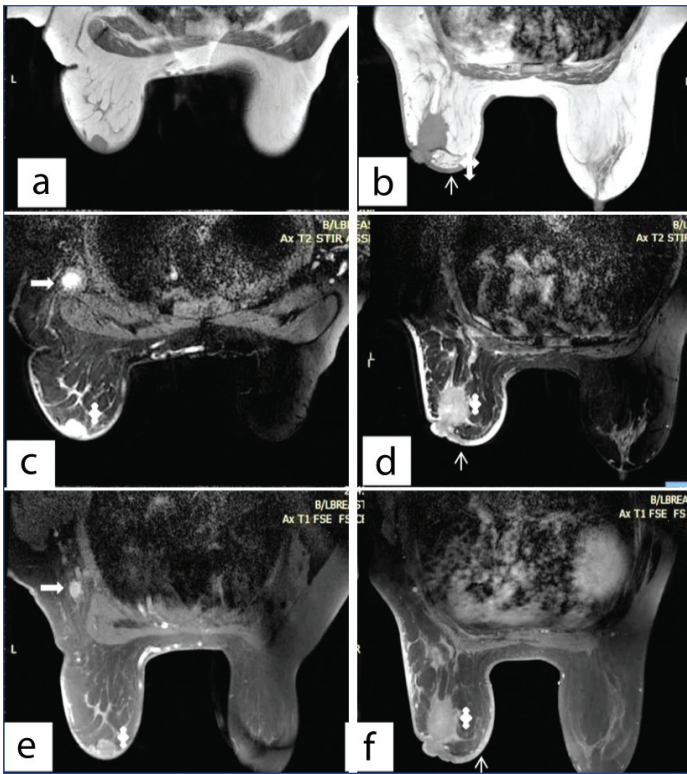
[Table/Fig-10]: Mammographic images (a,b) show irregular high density partially circumscribed mass with spiculated margins (solid white arrow), surrounding architectural distortion, nipple retraction and overlying skin thickening (quad arrow) in central breast and retroareolar location consistent with malignant lesion. Another smaller well circumscribed mass seen adjacent to above mentioned lesion. Correlated Ultrasound (c,d) show ill-defined hypoechoic mass (plus) with adjacent hypoechoic satellite lesion (thin white arrow).



[Table/Fig-11]: Mammographic images (a,b) show multiple variable sized round to oval high density mass lesions (plus) with well-defined margins in left breast. Differential diagnosis includes multiple fibroadenomas/cysts/ multifocal breast carcinoma/breast metastasis. Ultrasonography would be necessary to further characterise the lesion. On further work-up no other extra-mammary focal lesion could be identified.



[Table/Fig-12]: Ultrasonographic image shows multiple rounds to irregular hypoechoic mass lesions with peripheral vascularity. Lesions were confirmed to be multifocal carcinoma of breast on histopathological examination.



[Table/Fig-13]: MRI breast images show irregular mass in retro-areolar location (quad arrow) in left breast which appears isointense on T1, mildly hyperintense on T2 and shows heterogeneous postcontrast enhancement with surrounding architectural distortion, surrounding subcutaneous nodule, diffuse skin thickening (thin white arrow) and metastatic axillary lymphadenopathy (solid white arrow). Right breast appears normal in morphology and signal intensity.

CONCLUSION(S)

Breast lesions frequently present a diagnostic challenge for radiologists. Interpreting a normal variation or benign aberration as malignant- or vice versa- can significantly impact patient management. A thorough understanding of the diverse appearances of normal breast tissue, its aberrations, and pathological conditions on sonomammography and MRI is essential for accurate diagnosis and guiding appropriate management.

REFERENCES

- [1] Biswas SK, Banerjee S, Baker GW, Kuo CY, Chowdhury I. The mammary gland: Basic structure and molecular signaling during development. *Int J Mol Sci.* 2022;23(7):3883.

- [2] Shetty MK, Shah YP, Sharman RS. Prospective evaluation of value of combined mammographic and sonographic assessment in patients with palpable abnormalities of breast. *J Ultrasound Med.* 2003;22:263-68.
- [3] Peters NH, Borel Rinkes IH, Zuihthoff NP, Mali WP, Moons KG, Peeters PH. Meta-analysis of MR imaging in the diagnosis of breast lesions. *Radiology.* 2008;246:116-24.
- [4] Poplack SA, Tosteson TD, Kogel CA, Nagy HM. Digital breast tomosynthesis: Initial experience in 98 women with abnormal digital screening mammography. *AJR Am J Roentgenol.* 2007;189:616-23.
- [5] Zhang M, Arjmandi FK, Porembka JH, Seiler SJ, Goudreau SH, Merchant K, et al. Imaging and management of fibroepithelial lesions of the breast: Radiologic-pathologic correlation. *RadioGraphics.* 2023;43(11):e230051.
- [6] Ali EA, Talaat S. Ultrasound lexicon in diagnosis and management of breast fibroadenoma: When to follow up and when to biopsy. *Egypt J Radiol Nucl Med.* 2020;51:17.
- [7] Florea M, Chiorean AR, Roman RA, Rogojan L, Duma MM, Napoca C. Imaging spectrum of breast focal fibrocystic changes: mammography, conventional ultrasound, elastography and MRI appearances; Pathology correlation and differential diagnosis. *ECR.* 2014;C-1237.
- [8] Meyer JE, Ferraro FE, Frenna TH, DiPiro PJ, Denison CM. Mammographic appearance of a normal intramammary lymph node at atypical location. *AJR.* 1993;161:779-80.
- [9] Bhosale AA, Joshi AR, Ashturkar AV, Pathak GS. A case series. *Ann Trop Med Public Health.* 2012;5:262-64.
- [10] Kervancioglu S, Kervancioglu R, Ozkur A, Sirikci A. Primary tuberculosis of the breast. *Diagn Interv Radiol.* 2005;11:210-12.
- [11] Madhusudhan KS, Gamanagatti S. Primary breast tuberculosis masquerading as carcinoma. *Singapore Med J.* 2008;49(1):e3-e5.
- [12] Sripathi S, Ayachit A, Kadavigere R, Kumar S, Eleti A, Sraj A. Spectrum of imaging findings in paget's disease of the breast- A pictorial review insights imaging. 2015;6(4):419-29.
- [13] Lim HS, Feong SF, Lee FS, Park MH, Kim FW, Shin SS, et al. Paget's disease of the breast: Mammographic, US and MR Imaging findings with pathologic correlation. *Radiographics.* 2011;31:1973-87.
- [14] Abe M, Miyata S, Nishimura S, Iijima K, Makita M, Akiyama F, et al. Malignant transformation of breast fibroadenoma to malignant phyllodes tumour: Long-term outcome of 36 malignant phyllodes tumours. *Breast Cancer.* 2011;18:268-72.
- [15] Kalambo M, Adrada BE, Adeyefa MM, Krishnamurthy S, Hess K, Carkaci S, et al. Phyllodes tumour of the breast: Ultrasound-pathology correlation. *American Journal of Roentgenology.* 2018;210:173-79.
- [16] Chansakul T, Lai KC, Slanetz PJ. The post-conservation Breast: Part 1 expected imaging findings. *AJR.* 2012;198:321-30.
- [17] Ramani SK, Rastogi A, Mahajan A, Nair N, Sreashet T, MH. Imaging of the treated breast post breast conservation surgery/oncoplasty: Pictorial review. *World J Radiol.* 2017;9(8):321-29.
- [18] Eiada R, Chong J, Kulkarni S, Goldberg F, Muradali D. Papillary lesions of the breast: mri, ultrasound, and mammographic appearances. papillary lesions of the breast: MRI, ultrasound, and mammographic appearances. *AJR Am J Roentgenol.* 2012;198(2):264-71.
- [19] Brookes MJ, Bourke AG. Radiological appearances of papillary breast lesions. *Clin Radiol.* 2008;63:1265-73.
- [20] Kurz KD, Roy S, Saleh A, Diallo-Danebrock R, Skaane P. MRI features of intraductal papilloma of the breast: Sheep in wolf's clothing? *Acta Radiol.* 2011;52:264-72.
- [21] Dhillon GS, Bell N, Ginat DT, Levit A, Destounis S, O'Connell A. Breast MR imaging: What the radiologist needs to know. *J Clin Imaging Sci.* 2011;1:48.

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