
PICTORIAL ESSAY

Sonographic and Mammographic Features of Different Echogenic Breast Lesions: A Pictorial Essay

RLS Chan, T Wong, WY Fung, TS Chan, CM Chau, CY Lui, KF Ma

Department of Radiology, Princess Margaret Hospital, Hong Kong

INTRODUCTION

Ultrasonography is useful in the evaluation of clinically and mammographically detected breast masses. It is particularly useful in dense breasts that are more common in Asian women than in Caucasian women. According to the ACR BI-RADS Atlas (2013), hyperechogenicity is defined as having increased echogenicity relative to fat or equal to fibroglandular tissue.¹ This pictorial essay reviews breast lesions that are hyperechoic or heterogeneous with hyperechoic components on ultrasonography. Imaging features are highlighted to help differentiate between different echogenic lesions, and additional sonographic features that warrant biopsy. Benign and malignant lesions with pathological proof are shown with imaging and causes of echogenic appearance of breast lesions; their diagnosis, investigation and management are discussed.

BENIGN LESIONS

Lipoma

Lipoma is the most common echogenic breast lesion, and the most common pathology of biopsied echogenic lesions at our hospital. Clinically, they present as painless mobile soft lumps. Biopsy proven lipomas are

typically homogeneously echogenic because of closely packed adipose tissue due to proliferation. When small, they are usually oval and show no vascularity (Figure 1). They are often not evident on mammogram due to their small size and location at the subcutaneous fat that is also of fat density. When large, they appear as a fat-density lesion with thin rim on mammogram which confirms the diagnosis. If atypical features such as hypoechogenicity or isoechoic features are present, these lesions may be followed up or biopsied. Enlargement of lipomas on serial scanning is possible as they can enlarge with hormonal stimulation.²

Angiolipoma

Angiolipomas are variants of lipomas, with vascular proliferation among mature adipocytes. Similar to lipomas, angiolipomas present as painless palpable masses and are benign. Angiolipomas are described as uncommon in the literature³ but are quite commonly encountered in our pathology specimens of echogenic lesions. Sonographic features are similar to those of lipomas, appearing as subcutaneous circumscribed isoechoic to echogenic lesions, but they sometimes show increased vascularity. Angiolipomas cannot be

Correspondence: Dr RLS Chan, Department of Radiology, Princess Margaret Hospital, Hong Kong
Email: roischan@gmail.com

Submitted: 17 Oct 2019; Accepted: 28 Oct 2019

Contributors: All authors designed the study. RLSC and TW acquired the data, analysed the data, and drafted the manuscript. All authors critically revised the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of Interest: The authors have no conflicts of interest to declare.

Funding/Support: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data Availability: All data generated or analysed during the present study are available from the corresponding author on reasonable request.

Ethics Approval: This study was approved by the Kowloon West Cluster Research Ethics Committee (Ref: KWC-2019-0091). Because of the retrospective nature of the study, the requirement for informed consent from the patients was waived.

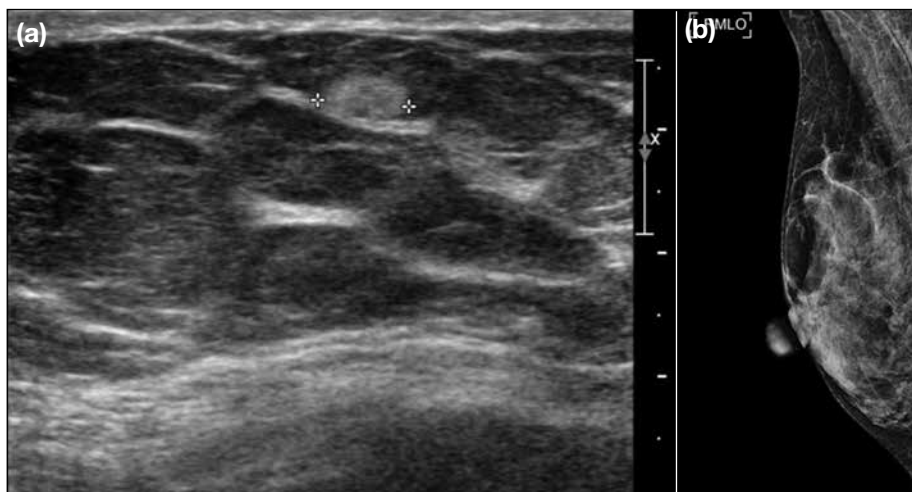


Figure 1. (a) Ultrasonogram of a 51-year-old woman who presented with a palpable lump at the lower outer quadrant of the left breast showing a subcutaneous oval parallel circumscribed hyperechoic lesion with no posterior features, calcifications or vascularity. It was pathologically confirmed to be a lipoma. (b) Right medio-lateral-oblique mammogram of a 63-year-old woman who presented with a palpable lump, showed a radiolucent mass with no calcification at the subcutaneous layer of the upper part of the right breast, indenting on the glandular tissue. Mammographic findings were typical of a lipoma.

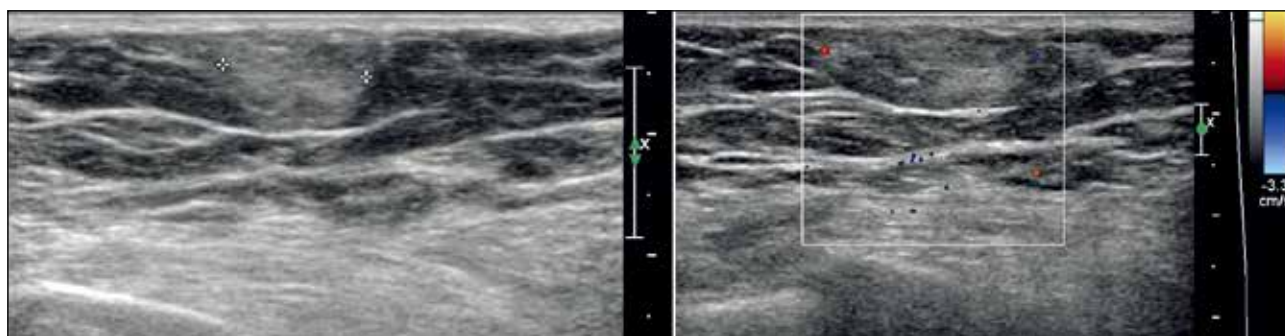


Figure 2. A 69-year-old woman presented with palpable left breast mass. Ultrasonogram showing a predominantly echogenic subcutaneous lesion, similar to that expected for a lipoma. However, mild peripheral vascularity is present, thus biopsy was performed and confirmed the lesion to be an angioliipoma.

differentiated from lipomas if no increased vascularity is seen on sonography (Figure 2). If increased vascularity is present, biopsy is warranted to exclude a malignant cause.⁴

Hamartoma

Hamartomas are benign lesions that contain glandular, fibrous, and fatty tissue. They usually present as painless masses or as an incidental finding. Breast-within-a-breast appearance describes the typical mammographic finding of a well-defined mixed density mass with similar appearance to the breast itself. A thin lucent rim of fatty glandular tissue on mammogram, and a corresponding echogenic rim on sonography may be seen (Figure 3). Echogenicity of the lesion varies depending on the amount of fat inside the hamartoma.² Biopsy is not required in cases with a typical appearance.

Intramammary Lymph Node

Intramammary lymph nodes are most commonly located at the upper outer quadrant of the breast. Typical features of echogenic fatty hilum, oval shape, and hilar vascularity are often present (Figure 4). They may be obscured on mammogram due to the presence of adjacent glandular breast tissue. If imaging features are typical, biopsy is not required.⁵

Abscess/Infected Galactocele

Abscesses often occur in lactating women who first present with fever, breast erythema and pain due to background mastitis, then later with a developing lump. Less commonly, abscesses may occur in non-lactating women with predisposing factors such as diabetes, smoking, and superimposed infection in cysts or duct ectasia. Diagnosis is usually made by history and

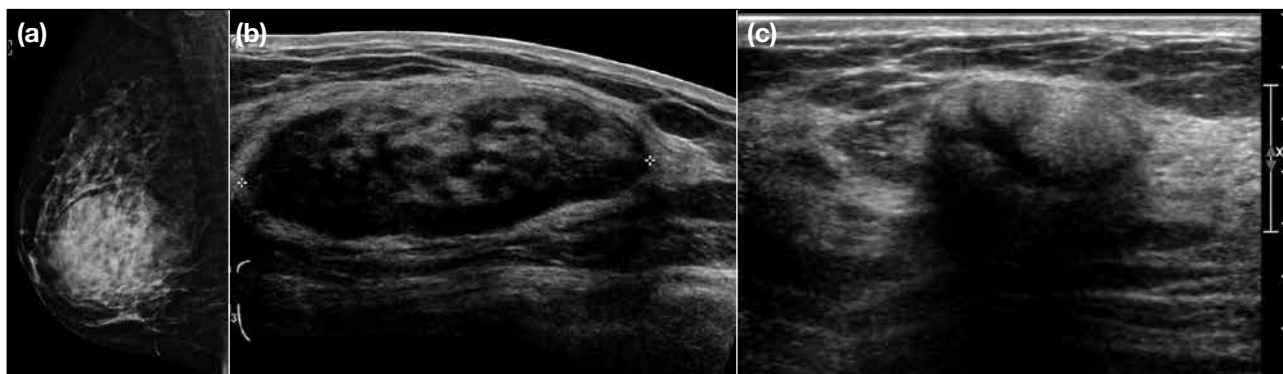


Figure 3. A 48-year-old woman presented with a painless palpable mass in the right breast. (a) Mammogram showing mass of mixed fat and equal density with a lucent rim. Ultrasonogram showing an oval circumscribed heterogeneous mass with hyperechoic areas, likely corresponding to fat component. Findings are typical of a breast hamartoma. (c) A 59-year-old woman presented with a painless palpable right breast mass. Ultrasonogram showing an oval circumscribed echogenic mass with posterior shadowing, pathologically proven to be a hamartoma.

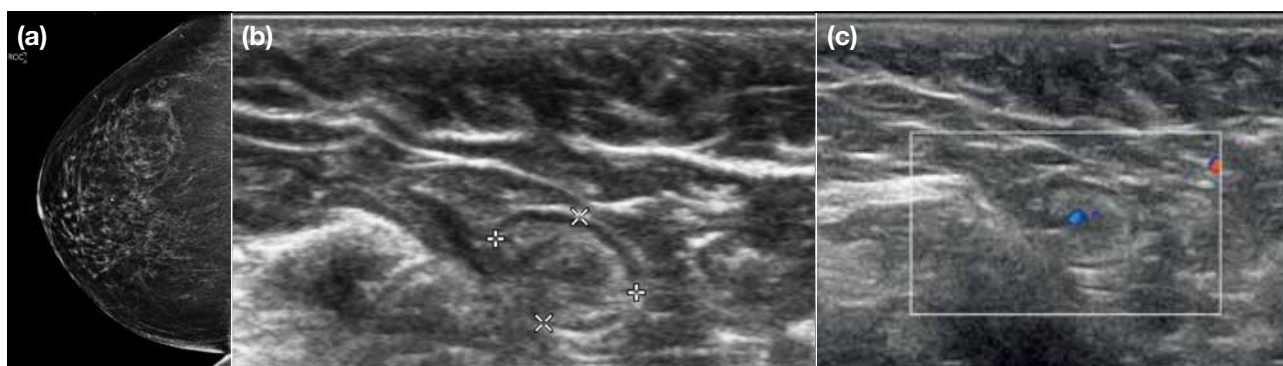


Figure 4. (a) Right craniocaudal mammogram of a 76-year-old woman showing a round circumscribed equal density lesion with a lucent centre at the outer part of the breast. (b, c) Ultrasonogram of the right upper outer breast showing a corresponding oval circumscribed echogenic lesion with thin hypoechoic rim. Hilar vascularity is present. Mammographic and sonographic features are typical of intramammary lymph node.

sonographic appearance. Abscesses are often hypoechoic or of mixed cystic-solid appearance, although they may sometimes be hyperechoic due to the presence of debris or retention of infected milk (Figure 5). Often there is increased vascularity on Doppler assessment. Diagnosis by imaging is often adequate, but if it does not resolve on interval imaging, biopsy is necessary to exclude the rare possibility of inflammatory breast cancer. If the abscess is already liquefied or partially liquefied, treatment is usually a combination of antibiotics and drainage by fine needle aspiration, which often needs to be repeated. If it is just early inflammatory change or phlegmon, antibiotics and interval close follow-up scan are sufficient.⁶

Granulomatous Mastitis

Granulomatous mastitis is considered rare in Caucasian patients, but is commonly encountered in Asian patients in Hong Kong.⁷ It presents with a hard, often painless,

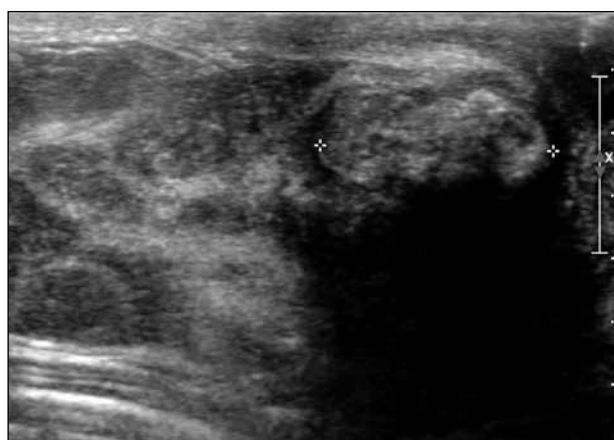


Figure 5. Ultrasonogram of the left breast of a 33-year-old lactating woman showing a hyperechoic circumscribed oval lesion with posterior shadowing at the subareolar region. Echogenicity is likely from milk component as abscess is less likely to be echogenic. Yellowish fluid was yielded on fine needle aspiration, pathologically confirmed to be inflammatory exudate, in keeping with a breast abscess.

mass. Mammography usually shows an equal to high density mass, with corresponding echogenic lesion on sonography (Figure 6).⁸ With a biopsy result of granulomatous reaction, the specimen is usually sent for a polymerase chain reaction test for detection of *Mycobacterium tuberculosis*, but most cases are shown to be idiopathic (or related to autoimmune disease) rather than related to infection. Treatment involves monitoring, corticosteroids, antibiotics, or surgical resection, depending on the cause and size of the lesion.

Fat Necrosis

Fat necrosis is a common condition that has a variety of mammographic and sonographic appearances. It mimics the appearance of other breast lesions due to the variable mixture of fat, fibrotic and calcific components (Figure 7).² Biopsy is often required unless there is

a typical history of trauma or previous intervention, together with typical fat appearance with calcifications on mammography.

Focal Fibrosis

Focal fibrosis is another common pathological result of echogenic breast lesions, but not frequently described in the literature. It is often of equal density on mammogram and mixed echogenicity on ultrasonography (Figure 8), due to clustering of thick fibrous stroma.⁹ There are no pathognomonic imaging features to distinguish it from tumours that can appear similar, thus diagnosis is by biopsy. When biopsy yields a pathological result of focal fibrosis, careful review of pathological-radiological concordance should be carried out.¹⁰ For slightly discordant cases, follow-up imaging may be considered but a false-negative result is rare.¹¹

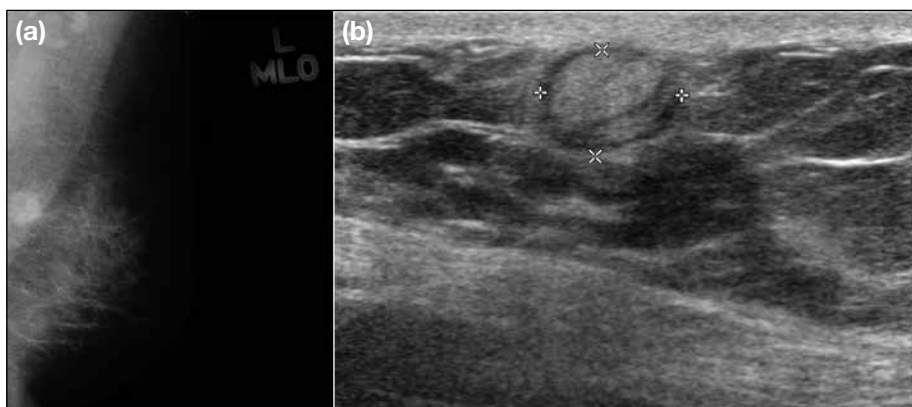


Figure 6. A 57-year-old woman presented with a 6-month history of firm non-tender lump in the left breast. (a) Mammogram showing a high density round mass, and (b) ultrasonogram showing the mass to be echogenic. Biopsy showed granulomatous infection and polymerase chain reaction test for detection of *Mycobacterium tuberculosis* was inconclusive. The lesion was excised with no recurrence over the next 9 years.

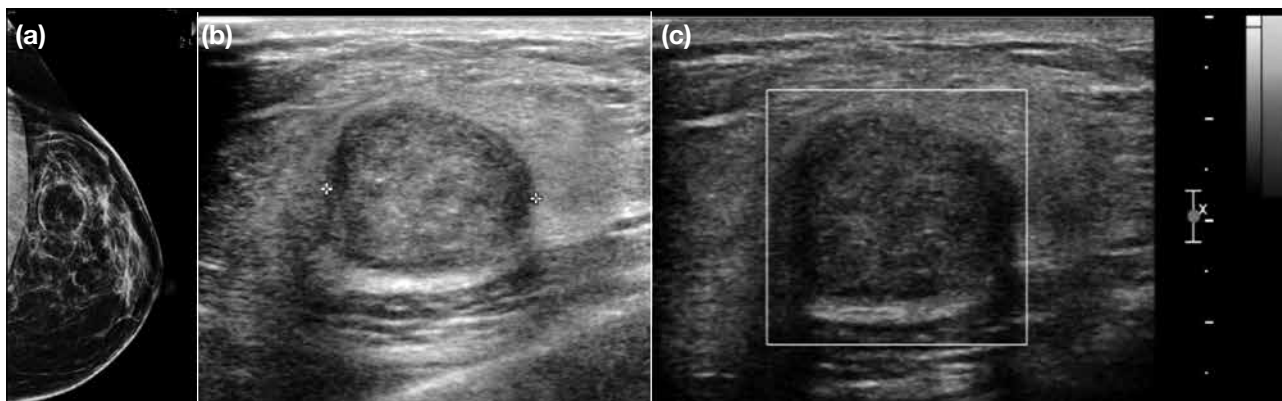


Figure 7. A 52-year-old woman with a history of paraffin breast injection presented with a palpable left breast lump. (a) Mammogram showing a circumscribed oval fat density mass with coarse microcalcifications within. (b, c) Ultrasonogram showing an echogenic oval circumscribed mass. History and imaging findings are typical of fat necrosis, confirmed pathologically upon excision.

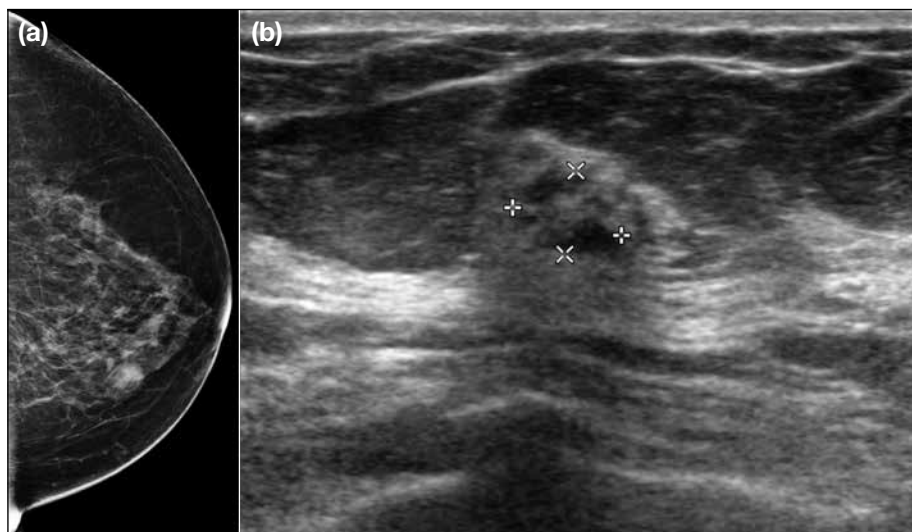


Figure 8. (a) Left craniocaudal mammogram of a 61-year-old woman with prior right breast conservation therapy for right breast cancer shows an oval circumscribed equal density lesion at the inner quadrant. (b) Ultrasonogram showing a lesion of mixed echogenicity at the corresponding location. It was classified as low suspicious. Biopsy showed focal fibrosis. She is pending interval follow-up mammography and ultrasonography.

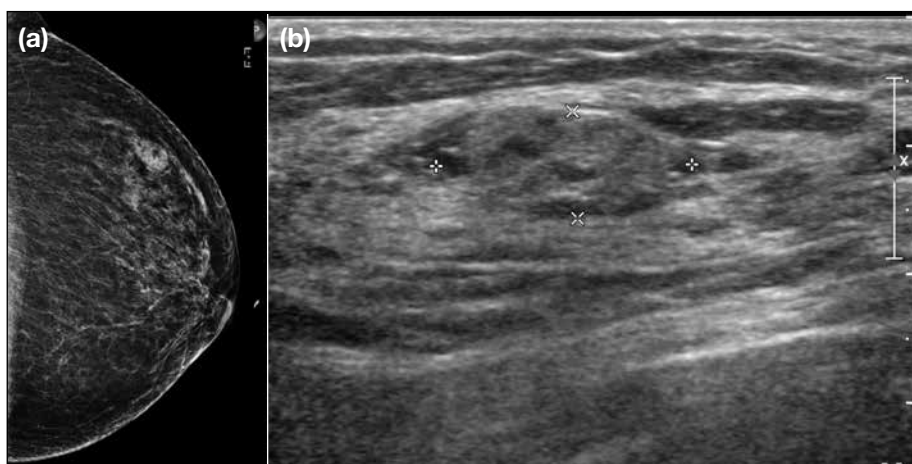


Figure 9. Screening mammogram of a 68-year-old woman with no palpable lesion. (a) Mammogram showing a mixed density mass at the outer quadrant of the left breast. (b) Ultrasonogram showing corresponding mixed but predominantly hyperechoic lesion. Biopsy confirmed fibrocystic disease with focal fibrosis.

Fibrocystic Disease/Apocrine Metaplasia

Fibrocystic disease usually presents with cyclical breast pain and palpable tender nodules and is often bilateral. Its imaging appearance is variable. On mammography, the breasts are often heterogenous or dense, with partially circumscribed masses that probably correspond to the cystic component. On ultrasonography, there is often diffuse heterogeneous echogenicity, with microcysts within (Figure 9). Occasionally, fibrocystic disease may appear mass-like. Imaging features overlap with other echogenic breast lesions that also appear as an equal density mass on mammogram, thus diagnosis is usually by biopsy. Apocrine metaplasia is a variant of fibrocystic change and usually appears as a cluster of microcysts but occasionally mimics an intracystic echogenic nodule (Figure 10).¹²

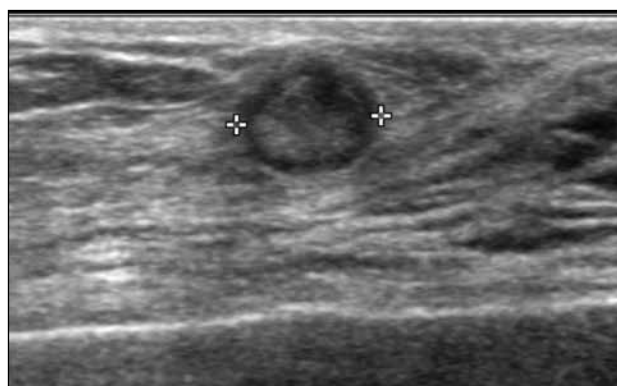


Figure 10. An 82-year-old woman with a palpable right breast nodule. Ultrasonogram showing a predominantly hyperechoic oval circumscribed lesion with thin hypoechoic rim. Biopsy showed apocrine metaplasia.

Free Silicone/Silicone Implant

Silicone within the parenchyma, including free silicone injection, extravasated silicone from a ruptured implant or silicone confined within an implant bag, should all have a characteristic snowstorm appearance on ultrasonography (due to silicone acoustic scattering) [Figure 11].¹³ Silicone granulomas are inflammatory lesions due to a foreign body reaction to free silicone in the breast. In patients with breast implants, they can be associated with extracapsular rupture. Extravasated silicone or silicone gel bleed can travel through the lymphatics and lodge in the lymph nodes, which then exhibit similar characteristics. Common locations of silicone granuloma are therefore at the edge of the implant or the axilla. Magnetic resonance imaging is another imaging modality of choice to evaluate augmented breasts.¹⁴ Silicone granuloma may sometimes mimic malignancy. Biopsy is needed when there are other suspicious features or if there is clinical concern.

Sebaceous Cyst

Sebaceous cyst is a lesion located at or just below the skin, often related to hair follicles. It can be of any echogenicity, but usually shows no increased vascularity unless inflamed (Figure 12). Biopsy and treatment are not required.¹²

Haematoma

This diagnosis is considered when patients volunteer a clear history of trauma, interventional procedure, or surgery. Most breast tumours are hypoechoic, but haemorrhage in vascular tumours will add an echogenic component to the mass. Sonographic appearance is variable dependent on the age of the haematoma. Hematomas are hypoechoic at the acute stage, complex cystic-solid at the subacute stage and become hyperechoic when chronic (Figure 13). With a clear history, early follow-up for shrinkage is adequate. Biopsy is indicated for non-resolving or enlarging lesions to exclude bleeding tumour.¹²

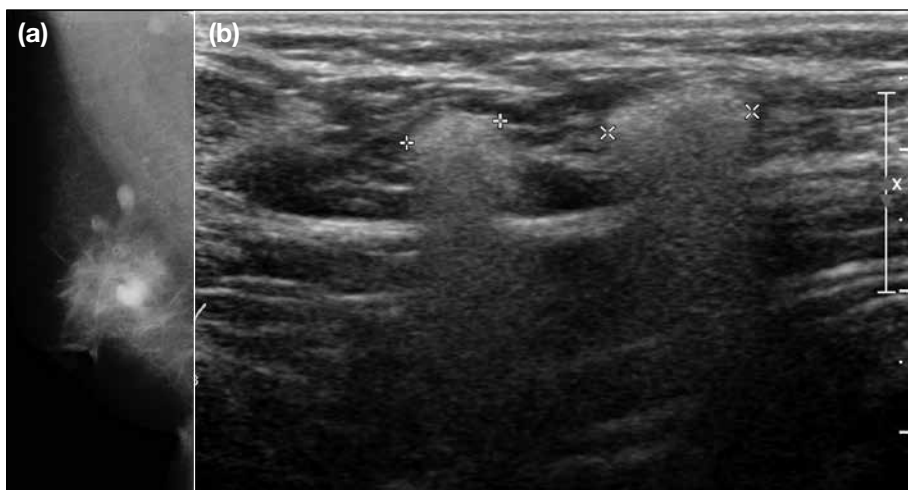


Figure 11. (a) Right mediolateral oblique mammogram of a 51-year-old woman with a history of free silicone injection presenting with breast lumpiness showing multiple dense oval masses. (b) Multiple corresponding echogenic lesions with shadowing, compatible with snowstorm sign are seen on sonography.

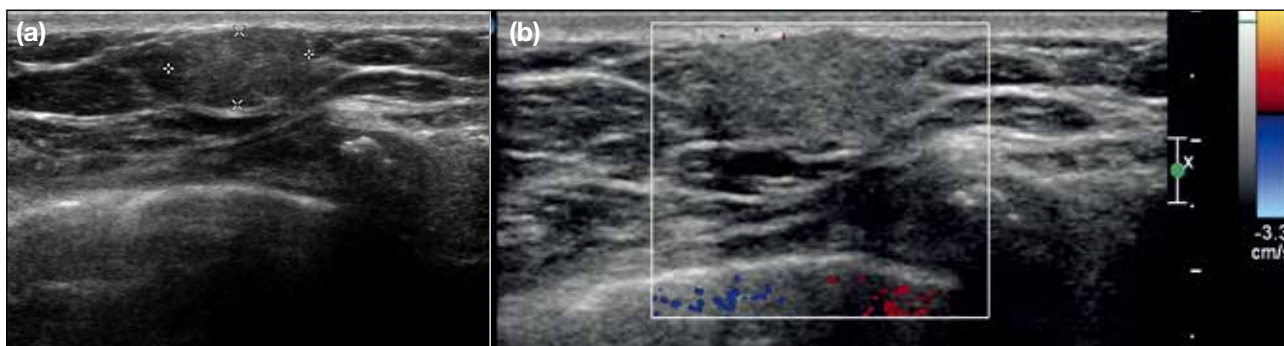


Figure 12. (a, b) A 60-year-old woman presented with a small nodule attached to the skin over the left breast. Sonography showing an echogenic lesion just beneath the skin. Biopsy confirmed presence of a sebaceous cyst.

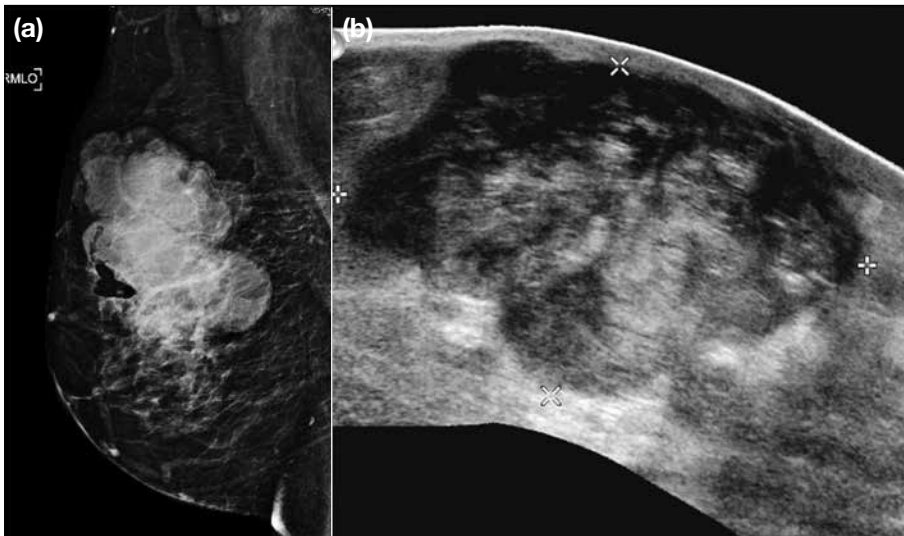


Figure 13. (a) Right mediolateral oblique mammogram of a 62-year-old woman with a large right breast mass showing an irregular equal density breast mass. (b) Ultrasonogram showing that the mass is irregular and predominantly echogenic. Biopsy confirmed a phyllodes tumour with large haemorrhagic component, which explains the large non-vascular echogenic component.

Haemangioma

Haemangiomas are rare benign breast tumours that are often asymptomatic and usually an incidental finding on screening mammograms. They are often located superficially. The most common mammographic appearance is that of a lobulated mass, rarely with coarse or punctate calcifications. On sonography, they are usually oval with circumscribed margins. Echogenicity and vascularity on Doppler examination are variable, depending on the proportion of capillary, venous and fibrous components (Figure 14).^{3,15} Diagnosis is usually made on biopsy in view of the non-specific appearance. Lesions with non-classic imaging or pathological features should be excised, as angiosarcoma should be excluded.¹⁵ Management of haemangiomas with pathological-radiological concordance is controversial, and the decision for conservative versus surgical management should be made following discussion between the patient and surgeon.¹⁶

MALIGNANT LESIONS

Primary Breast Carcinomas

The majority of primary breast carcinomas are hypoechoic on ultrasonography; however, a minority appears hyperechoic. The question is then how to distinguish a malignant hyperechoic tumour from a benign one. In our experience, breast carcinomas with echogenic appearance on sonography have a corresponding equal or high-density mass on mammogram (Figures 15 and 16). In addition, pathologically confirmed breast cancers with echogenic appearance have at least one of the following sonographic features: indistinct, spiculated or angular

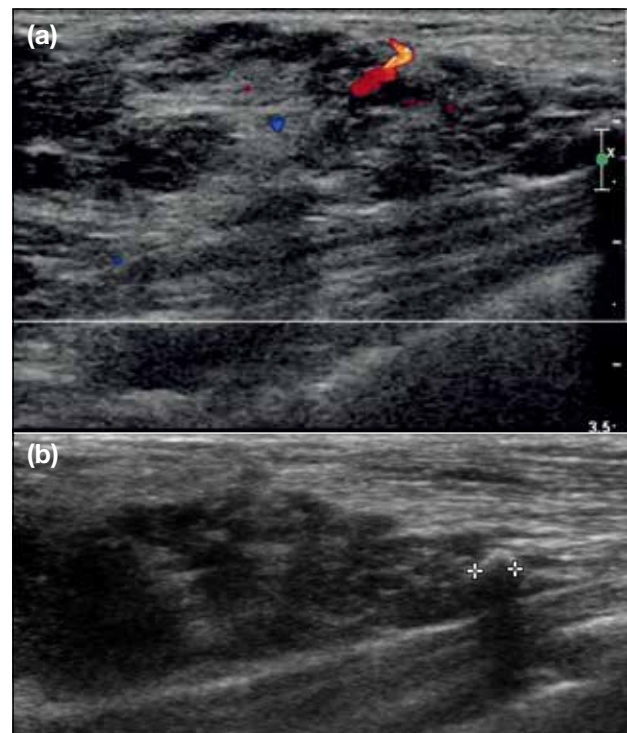


Figure 14. (a, b) Ultrasonogram of the right breast of a 57-year-old woman who presented with an enlarging lump at an old operative site showing a heterogeneous mixed hypoechoic and hyperechoic mass with internal vascularity and calcification, subsequently proven to be a residual haemangioma. She previously had a right breast lumpectomy without prior imaging, pathologically showing a venous haemangioma.

margins; irregular shape; non-parallel and/or increased internal vascularity (Figures 15 and 16). These features also correspond with sonographic features described in the literature to differentiate between malignant and

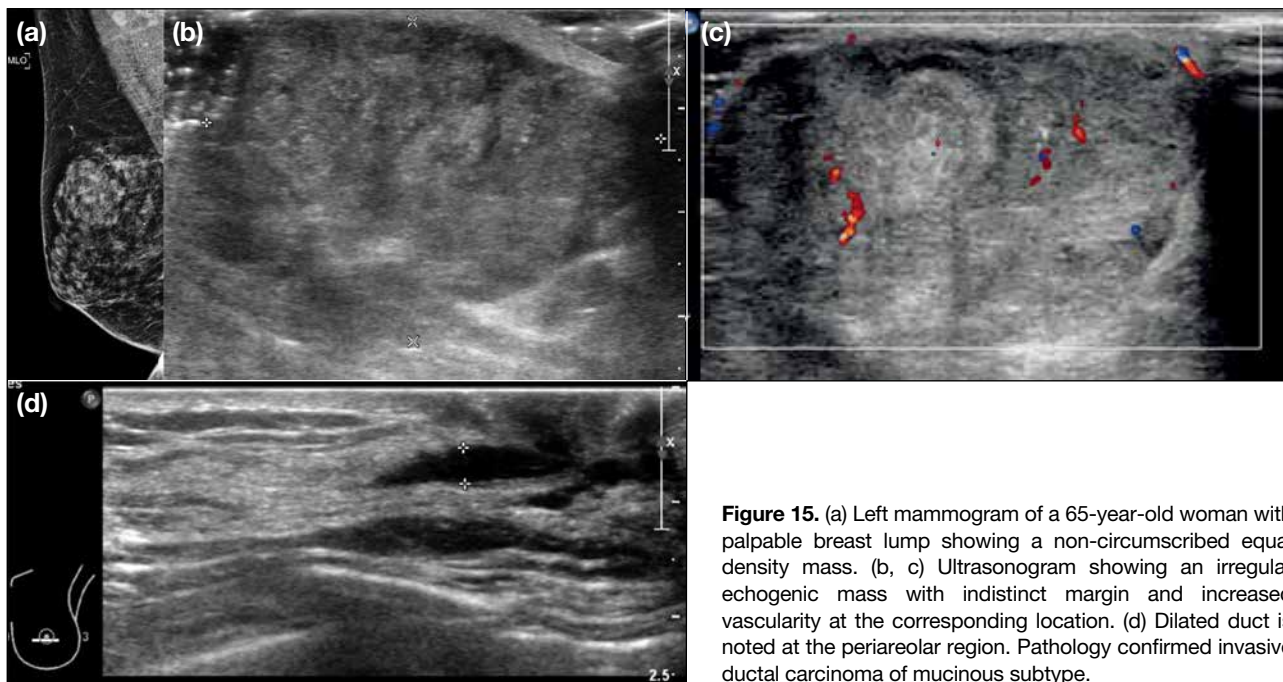


Figure 15. (a) Left mammogram of a 65-year-old woman with palpable breast lump showing a non-circumscribed equal density mass. (b, c) Ultrasonogram showing an irregular echogenic mass with indistinct margin and increased vascularity at the corresponding location. (d) Dilated duct is noted at the periareolar region. Pathology confirmed invasive ductal carcinoma of mucinous subtype.

benign lesions.¹⁷ In other words, echogenicity does not trump morphological appearance. These features may provide reassurance to our future practice in deciding which echogenic lesions to biopsy, and to safely label other lesions as benign or probably benign.

In addition, in our experience, echogenic primary breast tumours are typically invasive ductal carcinomas, with the majority being a mucinous subtype. However, in the literature, hyperechoic lesions are reported to be more frequent in invasive lobular carcinoma than invasive ductal carcinoma.¹⁸

Sarcomas

Sarcomas are rare aggressive stromal neoplasms of the breast, constituting 0.04% of all breast cancers.

Angiosarcomas are rare malignant tumours that arise from the endothelial cells of vascular channels. They may present as skin plaques or palpable masses. Prior radiation therapy is a risk factor. To differentiate from haemangiomas, angiosarcomas are usually intraparenchymal (rather than subcutaneous), and usually are larger (>3 cm) at diagnosis. Mammographically, they are usually an ill-defined irregular mass with no calcifications. Sonographically, they are often hypoechoic, but have been reported as hyperechoic.¹⁹

Liposarcomas of the breast are extremely rare constituting only 0.3% of all mammary sarcomas. They occur de novo or derive from a phyllodes tumour. On mammography, liposarcomas are of high density, mixed with fat density. On ultrasonography, they are predominantly hypoechoic, with echogenic regions corresponding to fat, dense vascular and stromal components (Figure 17). Increased vascularity is often present.²⁰

These patients are treated surgically with or without adjuvant radiation and chemotherapy. Prognosis is grave due to the high rate of recurrence and metastasis.

Primary Breast Lymphoma

Primary breast lymphoma is rare and constitutes less than 0.5% of all breast cancers. It is defined as lymphoma with breast the only organ affected. It usually presents as a palpable solitary mass. The most typical mammographic feature is of a solitary lobular or irregular mass; non-calcified and non-spiculated, unlike primary breast carcinoma. Sonographically, it is usually hypoechoic with increased vascularity, but mixed hyperechoic and hypoechoic appearance has also been described (Figure 18).²¹ Diagnosis is by biopsy. There is no standard treatment regimen.

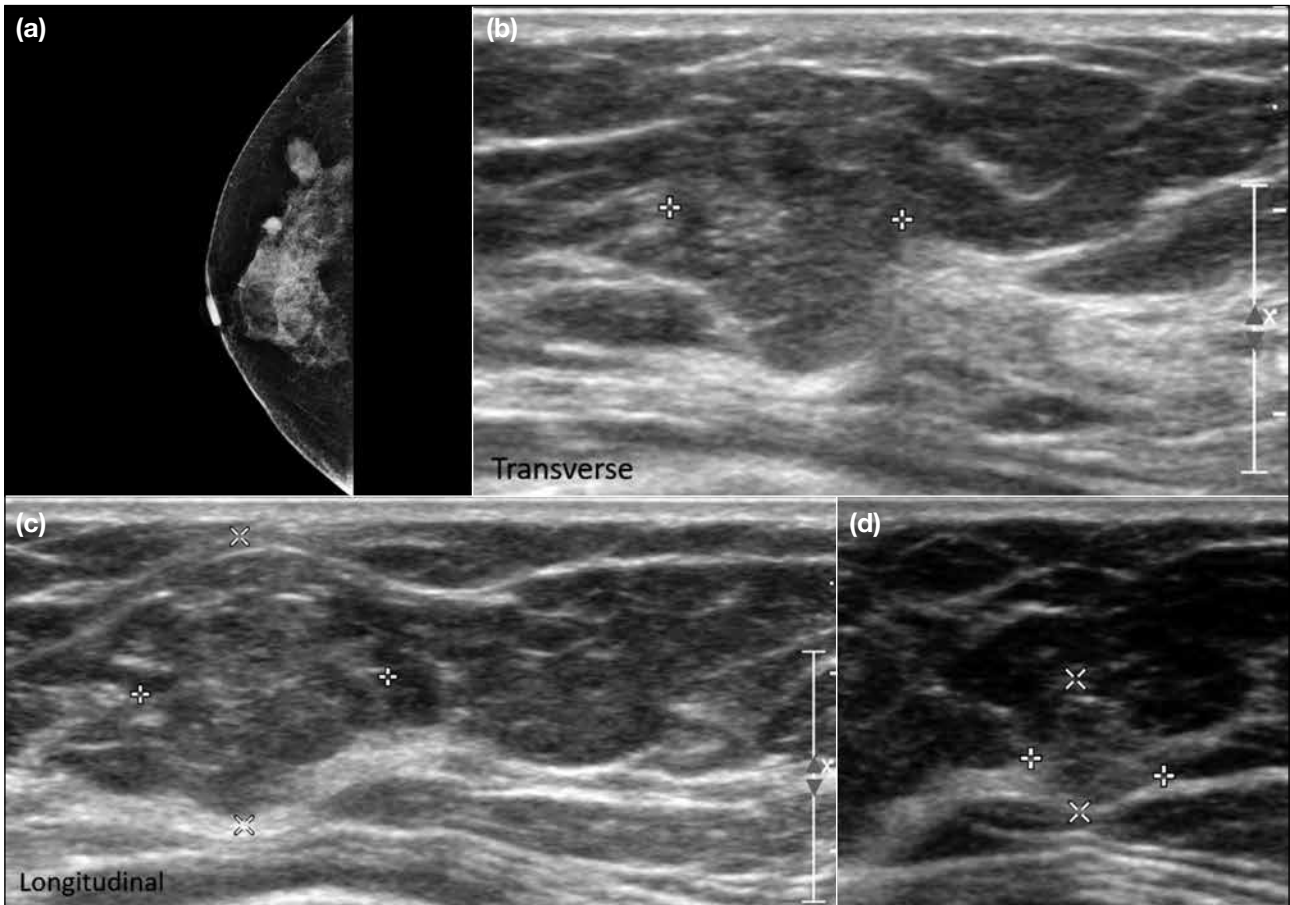


Figure 16. (a) Right craniocaudal mammogram of a 71-year-old woman showing two irregular high-density lesions at the outer part of the right breast, the more lateral one with indistinct margin, and the more medial one with spiculated margin. (b-d) Ultrasonograms showing a hyperechoic non-parallel lesion with indistinct margin corresponding to the more lateral lesion. A smaller hyperechoic non-parallel lesion with indistinct and slightly angulated margin is noted corresponding to the more medial lesion. Biopsy of the two lesions confirmed multifocal invasive ductal carcinoma at the upper outer quadrant of right breast.

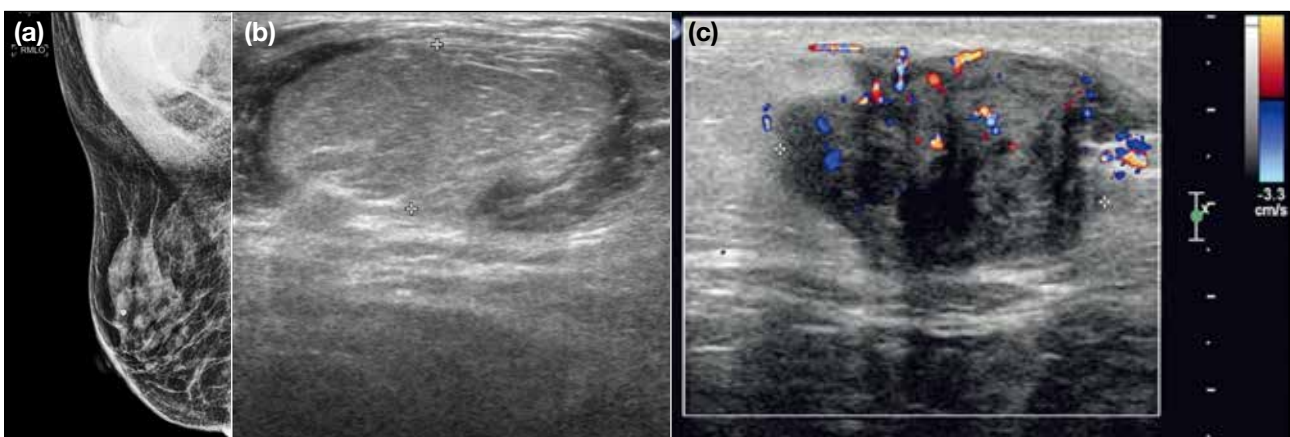


Figure 17. (a) Right mediolateral oblique mammogram of a 71-year-old woman who presented with a right axillary mass showing a mixed high and fat density mass at the right axilla. (b) Ultrasonography shows the lateral part of the mass as oval and parallel with obscured margin. (c) Medially, there is a more hypoechoic component with increased vascularity. In view of the fat component, liposarcoma was suspected clinically and subsequently confirmed by pathology.

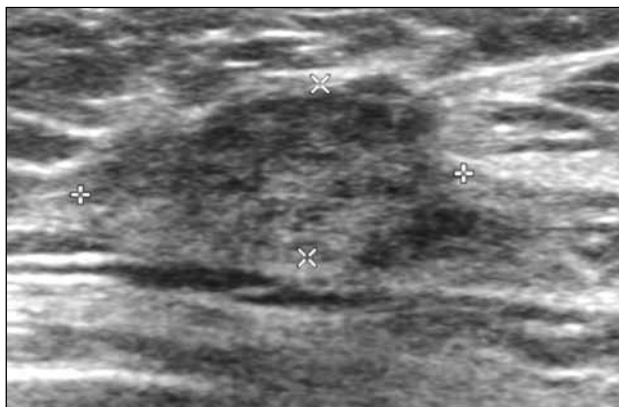


Figure 18. Ultrasonogram of a 71-year-old woman with known lymphoma presenting with palpable right breast mass. An irregular mass with heterogeneous echogenicity with echogenic component is evident at the outer part of the right breast. It has obscured margins. Biopsy confirmed lymphoma involvement.

Metastasis

Metastasis to the breast is uncommon, constituting less than 2% of breast cancers. The more common primary tumours to metastasise to the breast include secondary lymphoma and melanoma. Lung cancer, ovarian cancer and rhabdomyosarcoma are less commonly indicated.²²

Lymphoma is the most common tumour to metastasise to the breast. Melanoma has also been described to metastasise to the breast, but no case has been encountered at our unit, likely because melanoma is rare in Hong Kong.

Most metastases present as multiple bilateral palpable painless breast masses. Breast metastases are usually non-calcified and non-spiculated on mammography, unlike primary breast carcinoma. Sonographically, they are more often hypoechoic, but hyperechoic lesions have also been described.²³

CAUSES OF ECHOGENIC APPEARANCE IN BREAST LESIONS

Lesions appear echogenic because they reflect more of the sound emitted by the ultrasound probe. More reflection occurs when two adjacent tissues have greater differences in acoustic impedance, such as at an interface between fat and soft tissue, or between fibrous tissue and soft tissue. As fat, fibrous tissue, milk, silicone and blood products all have a lower acoustic impedance than soft tissue, such lesions have a typical or not uncommon echogenic appearance on ultrasonography.

The majority of echogenic lesions are benign. Fat-containing benign lesions include lipoma, angioliipoma, hamartoma, intramammary lymph node (fatty hilum), fat necrosis and sebaceous cysts. Fibrous lesions include focal fibrosis, fibrocystic disease and haemangioma (fibrous stroma). Galactoceles, silicone granulomas, and haematomas are echogenic because of the milk content, silicone, and blood products, respectively. Malignant echogenic lesions are uncommon, the main cause being liposarcoma, where assessment of its ultrasound features may differentiate from other benign entities.

Some echogenic lesions that we have encountered have a more common hypoechoic appearance. They include non-lactation-related abscesses, granulomatous mastitis, primary breast carcinoma, sarcoma, secondary lymphoma, and metastases. In particular, tumours are usually hypoechoic as they have higher density than normal soft tissue, and thus have a higher acoustic impedance.

The likely reason for the echogenic appearance in isolated tumour cases is unclear although a previous case report described an unusual case of hyperechoic liver nodule caused by Hodgkin's lymphoma, showing increased fat deposition inside the hepatocytes surrounded by lymphoma infiltrates in the pathological specimen.²² Increased fat deposition has been postulated as a cause of increased echogenicity in secondary breast lymphoma, although there is no similar case report correlating the sonographic appearance to histopathological characteristics of breast tumours.

DIAGNOSIS INVESTIGATION AND MANAGEMENT

Particular patient characteristics and additional sonographic and mammographic features help differentiate between various benign and malignant echogenic breast lesions (Figure 19¹⁰).

Patient history should always be reviewed, as previous breast augmentation; lactating history and septic features in a patient with suspected breast abscess; and history of recent intervention in a patient with suspected haematoma will aid diagnosis and prevent unnecessary biopsy.

Recognising certain specific appearances, such as the breast-in-breast appearance of hamartomas, echogenic fatty hilum of intramammary lymph nodes and snowstorm

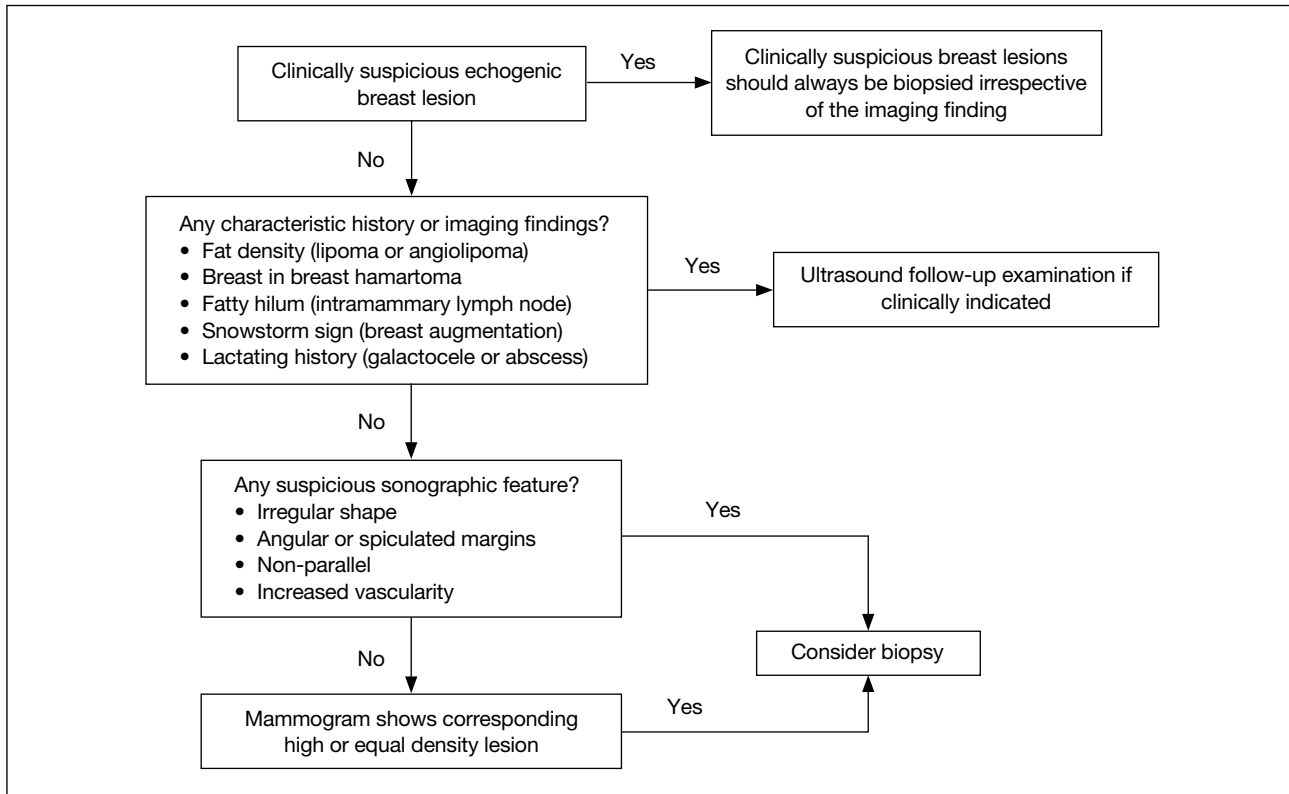


Figure 19. Flowchart for diagnosis and investigation of sonographically echogenic lesions.¹⁰

sign in augmented breasts will prevent biopsy of certain benign echogenic breast lesions.

CONCLUSION

The vast majority of echogenic breast lesions are benign, but it is vital to not miss diagnosis of the minority that are malignant. Lesions with suspicious sonographic features—such as spiculated or angular margins, irregular shape, or non-parallel or increased internal vascularity—or with corresponding equal or high-density mass on mammogram should be biopsied.

REFERENCES

- Mendelson EB, Böhm-Vélez M, Berg WA, Whitman GJ, Feldman MI, Madjar H, et al. ACR BI-RADS® Ultrasound. In: ACR BI-RADS® Atlas, Breast Imaging Reporting and Data System. Reston, VA, American College of Radiology; 2013. p 309.
- Pui MH, Movson IJ. Fatty tissue breast lesions. *Clin Imaging*. 2003;27:150-5.
- Adrada B, Wu Y, Yang W. Hyperechoic lesions of the breast: radiologic-histopathologic correlation. *AJR Am J Roentgenol*. 2013;200:W518-30.
- Darling ML, Babagbemi TO, Smith DN, Brown FM, Lester SC, Meyer JE. Mammographic and sonographic features of angioliipoma of the breast. *Breast J*. 2000;6:166-70.
- Dialani V, Westra C, Venkataraman S, Fein-Zachary V, Brook A, Mehta T. Indications for biopsy of imaging-detected intramammary and axillary lymph nodes in the absence of concurrent breast cancer. *Breast J*. 2018;24:869-75.
- Trop I, Dugas A, David J, El Khoury M, Boileau JF, Larouche N, et al. Breast abscesses: evidence-based algorithms for diagnosis, management, and follow-up. *Radiographics*. 2011;31:1683-99.
- Patel RA, Strickland P, Sankara IR, Pinkston G, Many W, Rodriguez M. Idiopathic granulomatous mastitis: case reports and review of literature. *J Gen Intern Med*. 2010;25:270-3.
- Al-Khawari HA, Al-Manfouhi HA, Madda JP, Kovacs A, Sheikh M, Roberts O. Radiologic features of granulomatous mastitis. *Breast J*. 2011;17:645-50.
- Venta LA, Wiley EL, Gabriel H, Adler YT. Imaging features of focal breast fibrosis: mammographic-pathologic correlation of noncalcified breast lesions. *AJR. Am J Roentgenol*. 1999;173:309-16.
- Revelon G, Sherman ME, Gatewood OM, Brem RF. Focal fibrosis of the breast: imaging characteristics and histopathologic correlation. *Radiology*. 2000;216:255-9.
- Rosen EL, Soo MS, Bentley RC. Focal fibrosis: a common breast lesion diagnosed at imaging-guided core biopsy. *AJR Am J Roentgenol*. 1999;173:1657-62.
- Gao Y, Slanetz PJ, Eisenberg RL. Echogenic breast masses at US: to biopsy or not to biopsy? *Radiographics*. 2013;33:419-34.
- DeBruhl ND, Gorczyca DP, Ahn CY, Shaw WW, Bassett LW. Silicone breast implants: US evaluation. *Radiology*. 1993;189:95-8.
- Wong T, Lo LW, Fung PY, Lai HY, She HL, Ng WK, et al.

- Magnetic resonance imaging of breast augmentation: a pictorial review. *Insights Imaging*. 2016;7:399-410.
15. Mesurolle B, Sygal V, Lalonde L, Lisbona A, Dufresne MP, Gagnon JH, Kao E. Sonographic and mammographic appearances of breast hemangioma. *AJR Am J Roentgenol*. 2008;191:W17-22.
 16. Jesinger RA, Lattin Jr GE, Ballard EA, Zelasko SM, Glassman LM. Vascular abnormalities of the breast: arterial and venous disorders, vascular masses, and mimic lesions with radiologic-pathologic correlation. *Radiographics*. 2011;31:E117-36.
 17. Hong AS, Rosen EL, Soo MS, Baker JA. BI-RADS for sonography: positive and negative predictive values of sonographic features. *AJR Am J Roentgenology*. 2005;184:1260-5.
 18. Cawson JN, Law EM, Kavanagh AM. Invasive lobular carcinoma: sonographic features of cancers detected in a BreastScreen Program. *Australas Radiol*. 2001;45:25-30.
 19. Glazebrook KN, Magut MJ, Reynolds C. Angiosarcoma of the breast. *AJR Am J Roentgenol*. 2008;190:533-8.
 20. Mardi K, Gupta N. Primary pleomorphic liposarcoma of breast: a rare case report. *Indian J Pathol Microbiol*. 2011;54:124-6.
 21. Lyou CY, Yang SK, Choe DH, Lee BH, Kim KH. Mammographic and sonographic findings of primary breast lymphoma. *Clin Imaging*. 2007;31:234-8.
 22. Bartella L, Kaye J, Perry NM, Malhotra A, Evans D, Ryan D, et al. Metastases to the breast revisited: radiological-histopathological correlation. *Clin Radiol*. 2003;58:524-31.
 23. Hann A, Trenker C, Westhoff CC, Goerg C. Unusual hyperechoic appearance of Hodgkin's lymphoma in the liver. *Ultrasound Int Open*. 2015;1:E25-6.