

Imaging echogenic breast masses

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The ACR BI-RADS lexicon describes an echogenic breast mass on ultrasonography (US) as having an echogenicity greater than subcutaneous fat or equal to fibroglandular tissue.¹ An echogenic sonographic appearance is attributed histologically to fat, fibrous contents, vascular origin or high cellularity of lesions.^{2,3}

Echogenic breast lesions are uncommon, comprising only 0.6-6% of breast masses and 0.6% of all biopsied lesions.^{3,4} The majority of these lesions are benign. There are rare malignancies that can present as echogenic masses however, and thorough sonographic assessment according to the ACR BI-RADS criteria must be performed to correctly categorize these lesions and avoid misdiagnosis.

In this article, we will review the imaging features of common benign and malignant echogenic breast lesions on ultrasound (Table 1), emphasizing their

Table 1. Common echogenic breast lesions on ultrasound

Benign	Malignant
Fat necrosis	Invasive ductal carcinoma (IDC)
Fibroadenoma	Invasive lobular carcinoma (ILC)
Lipoma	Mucinous carcinoma
Angiolipoma	Lymphoma
Hematoma	Metastasis
Hamartoma	Angiosarcoma
Silicone granuloma	
PASH	
Abscess	
Duct ectasia	
Epidermal and sebaceous cyst	
Galatocele	
Hemangioma	

correlation with clinical history, mammographic appearance, lesion location and ultrasound features to establish a

correct differential diagnosis, determine the need for biopsy and assess the imaging-pathology concordance after biopsy.

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Benign hyperechoic lesions

Fat necrosis

Fat necrosis is a common benign entity; it can result from direct trauma, surgery, radiation therapy or infection. On imaging it can mimic malignancy



FIGURE 1. Fat Necrosis. A 61-year-old woman with prior left lumpectomy and radiation therapy, found to have palpable radiolucent mass with dystrophic coarse calcifications at lumpectomy bed on mammogram (MG) (not shown). Ultrasound (US) image shows a predominantly echogenic mass with posterior shadowing.

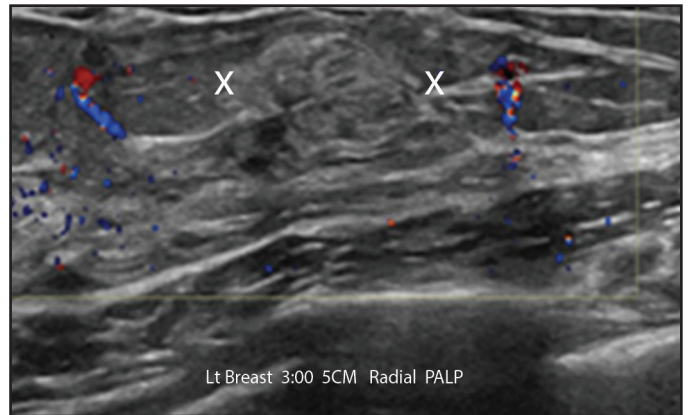


FIGURE 2. Fibroadenoma. A 30-year-old woman with a palpable left breast mass. US image with color Doppler shows a hyperechoic avascular solid mass.

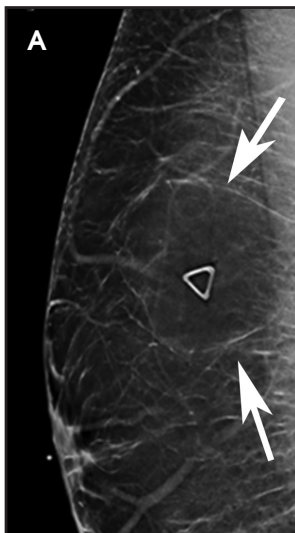


FIGURE 3. Lipoma. A 56-year-old woman with a palpable right breast mass at 9:00. (A) Mammogram shows a radiolucent mass surrounded by thin capsule (arrows). (B) US image shows a circumscribed echogenic mass.

depending on the extent of histiocytic infiltration, hemorrhage, fibrosis, and calcification.^{2,5}

The ultrasound appearance of fat necrosis is variable, ranging from cysts to complex cystic masses to hyperechoic masses.⁶ On mammography (MG), fat necrosis can present as lipid cysts, calcifications, focal asymmetries, spiculated masses or architectural distortion.⁴ Careful correlation with the patient's history and the mammogram findings is prudent to suggest the diagnosis and avoid biopsy (Figure 1).

Fibroadenoma

Fibroadenomas are common benign breast lesions that are composed of

stromal and epithelial components, are hormonally sensitive, and more frequent in younger women.³ On US, they typically present as an oval circumscribed mass, and >90% are uniformly hypoechoic. Rarely, they present as hyperechoic (4%) masses (Figure 2).⁷

Fat necrosis and fibroadenoma were the most frequent observed benign pathologies on ultrasound guided core biopsies of hyperechoic lesions.⁸

Lipoma

Lipomas are common benign fatty tumors in the breast that are composed of mature lipocytes, usually subcutaneous in location and often unilateral and solitary.^{2,4} On ultrasound, lipomas can

appear as hypoechoic, isoechoic, or hyperechoic masses.⁴ On mammography, it presents as a radiolucent fat density mass surrounded by a thin fibrous radiopaque capsule confirming benignity (Figure 3).^{2,4}

Angiolipoma

Angiolipomas are composed of mature lipocytes with variable vascular proliferation.⁹ The pathologic hallmark is scattered microthrombi in small blood vessels.⁴ On US, angiolipomas are commonly round or oval subcutaneous isoechoic to hyperechoic masses with internal vascularity.^{4,9} Mammography usually shows a dense mass or mixed density asymmetry.^{4,9} There are no specific imaging features of angiolipomas however, and biopsy is needed for confirmation.^{4,9}

Hematoma

Breast hematoma is a localized collection of blood that can result from direct trauma, surgery, biopsy or rarely occur spontaneously in those with coagulopathy.^{4,9} The US appearance depends on the age of blood products; it can be hyperechoic from the acute to chronic stages.⁹ Lipomas, fat necrosis, primary breast cancer and hematologic metastases are in the differential diagnosis of a hyperechoic hematoma.⁹ Correlation with the patient's clinical history is essential for the correct

diagnosis. A history of trauma favors hematoma. When there is no clear history of trauma or a known extramammary malignancy, a short term follow-up or biopsy may be indicated to exclude malignancy (Figure 4).^{4,9}

Hamartoma (Fibroadenolipoma)

Hamartomas have an incidence of 0.1–0.7% in the breast.^{3,9} They are composed of variable proportions of fat, glandular and fibrous tissue which determines their imaging appearance.^{3,9} Frequently they

are asymptomatic, but they can present as painless masses. On mammography, hamartomas appear as mixed density (reflecting the fat to stroma ratio), circumscribed masses surrounded by a pseudocapsule.⁹ At US, these masses are compressible by the transducer and the echo pattern is usually hypoechoic, isoechoic, or mixed echogenicity; but 12–43% of hamartomas appear hyperechoic.³ If it increases in size or density on mammogram or the appearance is atypical, further workup with US and core biopsy are indicated (Figure 5).⁹

Silicone granuloma (siliconoma)

Siliconoma is an inflammatory mass arising from the presence of free silicone, related to extracapsular rupture or free silicone injection.^{4,10} On mammography, a silicone granuloma appears as a hyperdense mass of similar density to the silicone implant.⁴ Ultrasound shows a hyperechoic mass with well-defined anterior margin and posterior dirty shadowing “snowstorm sign” (Figure 6) or an anechoic cystic mass.^{4,10} Appropriate clinical or surgical history in the setting of aforementioned imaging findings is diagnostic for siliconoma.⁴

Pseudoangiomatous stromal hyperplasia (PASH)

PASH is a benign proliferative mesenchymal lesion of the breast stroma, seen in perimenopausal women or those

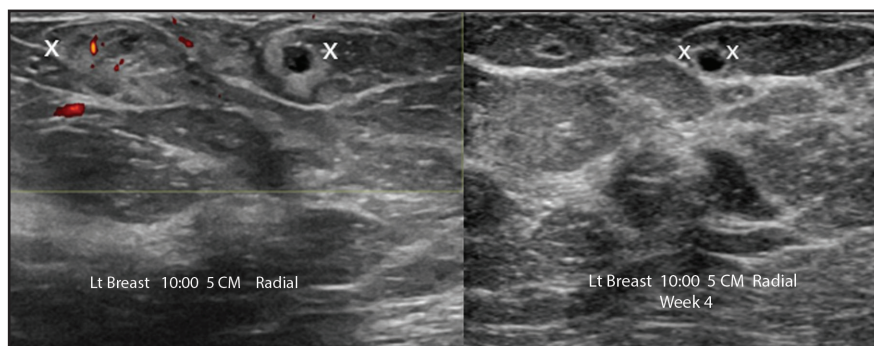


FIGURE 4. Hematoma. A 62-year-old woman on Coumadin reports a left breast bruise. Initial US image shows a hyperechoic mass with internal hypoechoic areas. US obtained 4 weeks later shows decrease of the mass size.

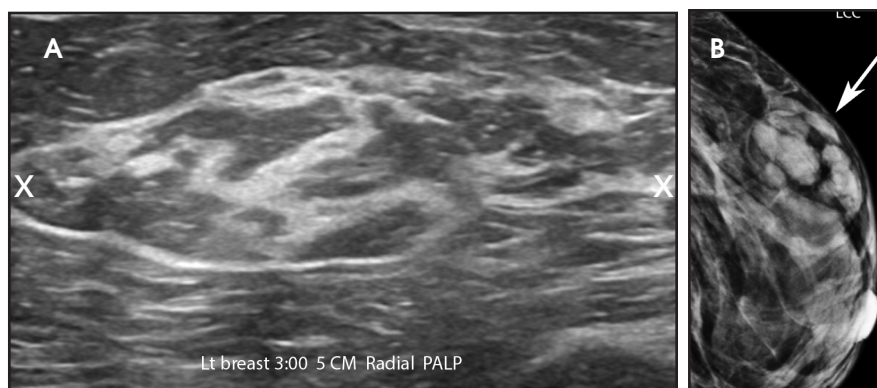


FIGURE 5. Hamartoma. A 56-year-old woman with an enlarging left breast mass at 3:00. (A) US image shows a heterogeneous solid mass corresponding to mixed density mass with pseudocapsule on MG (B, arrow).

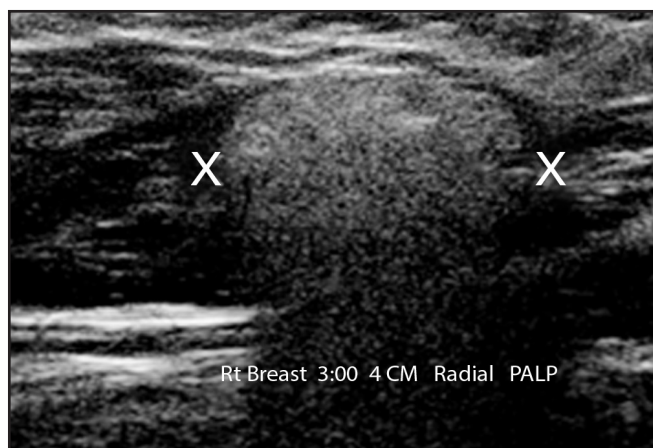


FIGURE 6. Silicone granuloma. A 54-year-old woman with history of silicone implant removal for rupture with a new palpable right breast mass at 3:00. US image shows a hyperechoic mass with dirty shadowing.

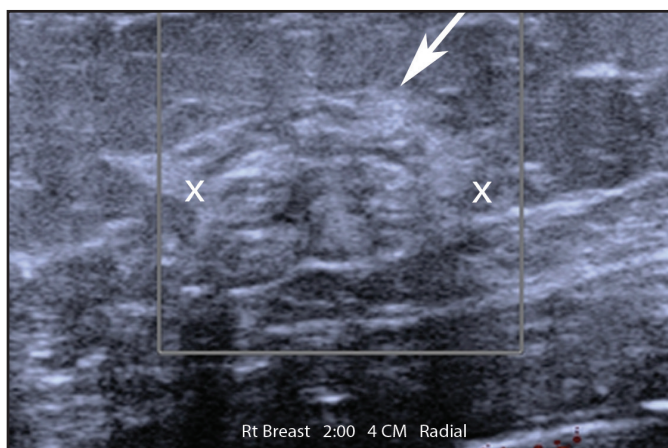


FIGURE 7. Pseudoangiomatous stromal hyperplasia (PASH). US image shows a new echogenic mass (arrow) corresponding to a developing asymmetry on mammogram (not shown).

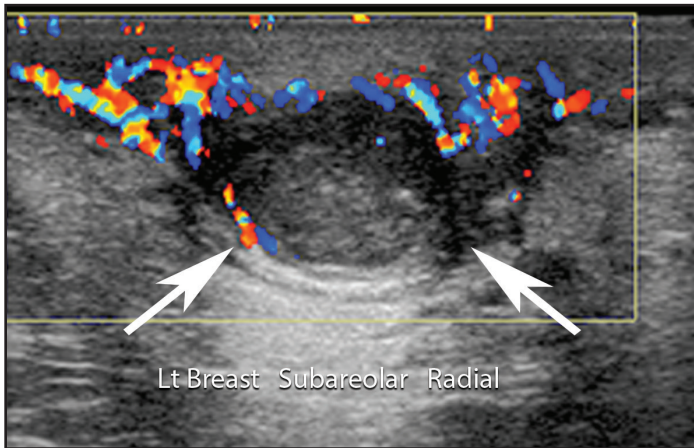


FIGURE 8. Abscess. A 32-year-old woman with fever and right breast pain. US image with color Doppler shows an echogenic mass (arrows) with peripheral vascularity.

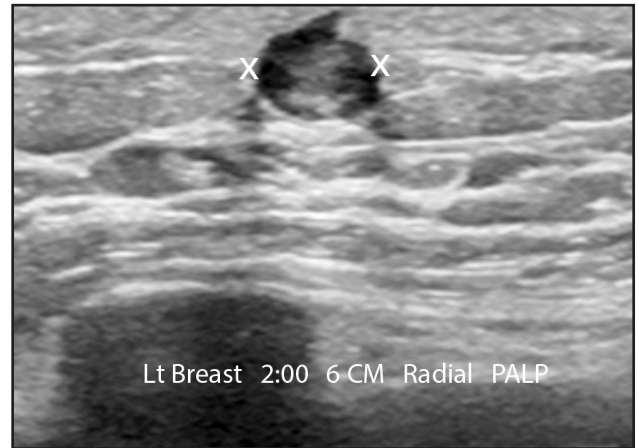


FIGURE 9. Epidermal inclusion cyst. A 20-year-old woman with a palpable left breast mass. US image shows a superficial predominantly echogenic mass with a tract to the skin.

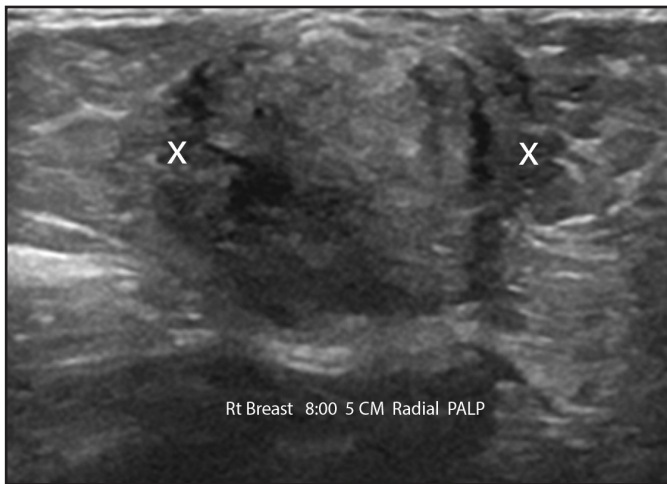


FIGURE 10. Galactocele. A 30-year-old woman who recently stopped breast-feeding with a palpable right breast mass. US image shows a heterogeneous mass with high internal echogenicity.

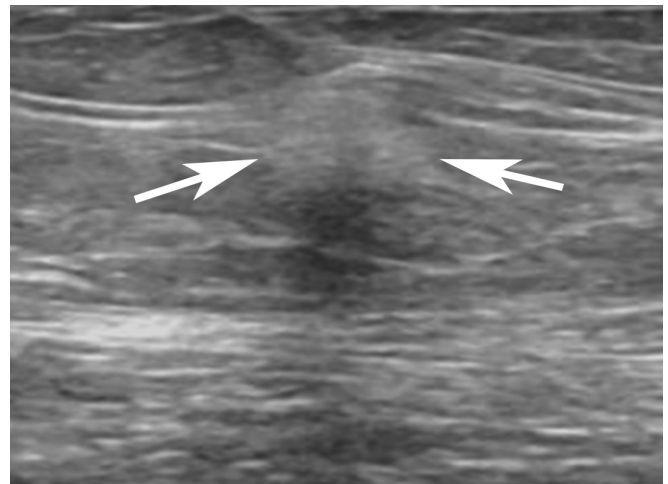


FIGURE 11. Invasive ductal carcinoma (IDC). An 80-year-old woman with a new 5mm spiculated mass on mammogram (not shown). US image shows a correlative irregular echogenic mass (arrows) with posterior shadowing.

receiving hormones.^{2,3} PASH may present as a rare nodular, and sometimes palpable, form or a diffuse form.^{2,3} At mammography, PASH can appear as a circumscribed, non-calcified mass or asymmetry.^{2,3} At US, PASH often appears as an ovoid or ill-defined, heterogeneous mass and rarely can be hyperechoic.^{2,3} The imaging features of PASH are not specific, and biopsy is necessary to exclude malignancy (Figure 7).⁴

Abscess

Abscess is a collection of pus within the breast, usually from mastitis, and presents with pain, erythema and fever.^{4,11} Abscesses can be classified as “puerperal” (related to childbirth or

lactation) or “nonpuerperal”.¹¹ Puerperal abscess are caused by penetration of staphylococcus aureus through a cracked nipple.^{4,11} Nonpuerperal abscesses are often associated with diabetes, smoking, obesity, and black race and can be subareolar or peripheral.^{4,11} At US, an abscess may be echogenic, but more often is a complex cystic mass with peripheral vascularity (Figure 8).^{4,11} Failure to respond to antibiotics and persistence on imaging, should prompt biopsy to exclude inflammatory breast cancer.^{4,11}

Duct ectasia

Duct ectasia is dilation of the retroareolar ducts from chronic in-

flammation.^{4,12} Clinically, it can be asymptomatic or present with nipple discharge. US shows anechoic dilated ducts with or without an avascular intraductal mass.^{4,12} Intraductal masses can have both benign and malignant pathologies: duct ectasia, fibrocystic change, papillary lesion, DCIS, and IDC.⁴ Central duct location, multiple similar appearing ducts without internal vascularity, smooth wall and lack of adjacent mass supports a benign pathology.^{4,12}

Epidermal and sebaceous cysts

Epidermal and sebaceous cysts are common dermal lesions and clinically indistinguishable.^{4,13} Both are retention

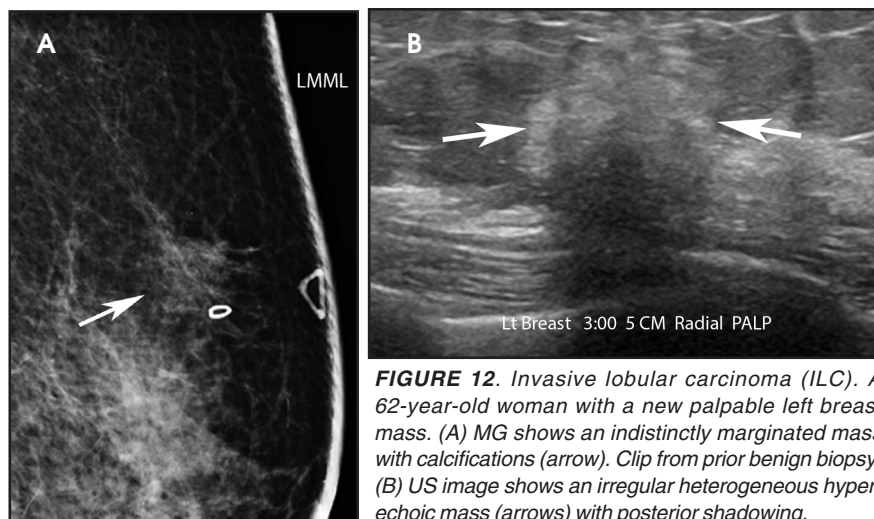


FIGURE 12. Invasive lobular carcinoma (ILC). A 62-year-old woman with a new palpable left breast mass. (A) MG shows an indistinctly margined mass with calcifications (arrow). Clip from prior benign biopsy. (B) US image shows an irregular heterogeneous hyperechoic mass (arrows) with posterior shadowing.

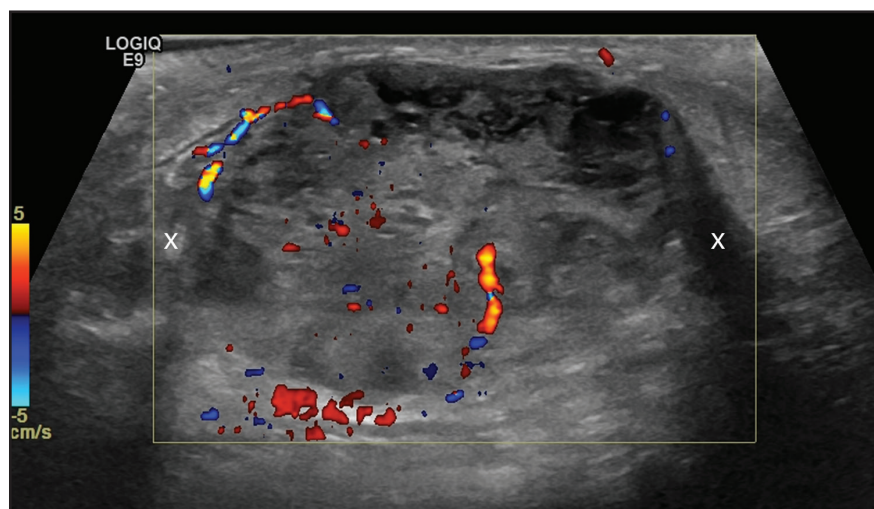


FIGURE 13. Mucinous carcinoma. A 104-year-old woman with melanoma and a palpable hypermetabolic mass in the medial left breast on PET-CT (not shown). US image with color Doppler shows a hypervascular hyperechoic mass with focal hypoechoic areas. Final pathology: mucinous carcinoma (mixed subtype).

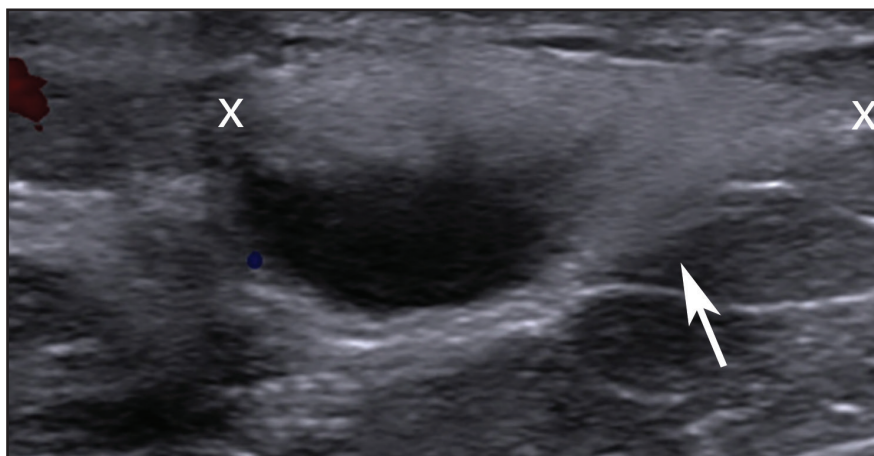


FIGURE 14. Lymphoma. A 72-year-old woman with a new circumscribed mass on screening mammogram (not shown). US image shows a corresponding mixed echogenic mass (arrow). Final pathology: B-cell lymphoma.

cysts arising from hair follicles plugged with keratin.¹³ They are usually palpable and may become inflamed with discharge seen from a small skin orifice.¹³ US appearance can be cystic, hypoechoic, or echogenic depending on the internal contents (Figure 9).¹³ Ultrasound demonstration of internal vascularity should prompt biopsy. In contrast, a dermal tract confirms a benign skin lesion.^{4,13} Needle biopsy of a suspected skin cyst should be avoided as rupture of the cyst can incite an intense inflammatory reaction.¹³

Galactoceles

Galactoceles are milk filled retention cysts caused by blockage of the breast lactiferous duct.⁴ They are common in pregnant or breast-feeding woman, typically presenting as a painless lump. The mammographic and ultrasound appearance depends on the percentage of fat and protein.¹⁴ A galactocoele that is predominately milk content has fat density on mammogram and is hyperechoic on US (Figure 10).^{4,14} Aspiration of a galactocoele is both diagnostic and therapeutic, yielding milky fluid.¹⁴

Hemangioma

Hemangiomas are common vascular tumors seen in the breast.^{3,9,15} Pathologically, there are two types: capillary and cavernous (more common subtype) related to the size of their vascular channels on histology.^{9,15} On US, they are usually superficial, oval, circumscribed masses. Their echotexture may be hypoechoic, isoechoic, or less commonly hyperechoic (33% of cases).^{3,9,15} The imaging appearance is not specific and biopsy is performed for diagnosis. Excessive bleeding can occur during biopsy, a clue to the diagnosis. Rarely, excision after biopsy is recommended to exclude angiosarcoma.¹⁵

Malignant hyperechoic lesions

Although typically hypoechoic, a small subgroup of breast malignancies (0.5%) can present as hyperechoic lesions.^{4,9,16}

Invasive ductal carcinoma (IDC)

IDC is the most common (75%) breast cancer, presenting as an asymptomatic

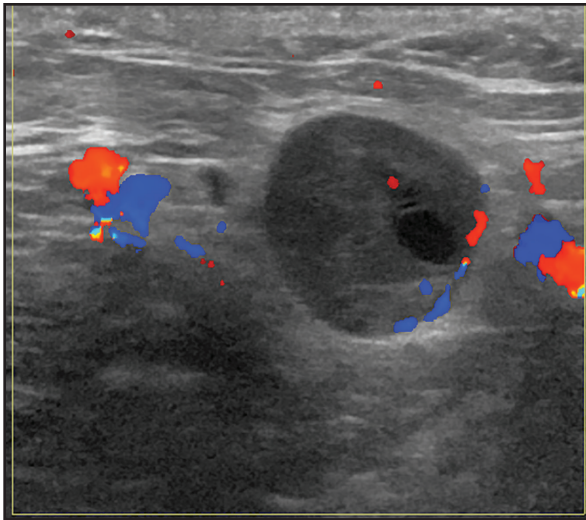


FIGURE 15. Melanoma metastasis. A 65-year-old woman with melanoma (upper back) and a hypermetabolic right axilla mass on PET-CT (not shown). US image with color Doppler of the right axilla shows a hypervascular hyperechoic round mass with internal hypoechoic area.

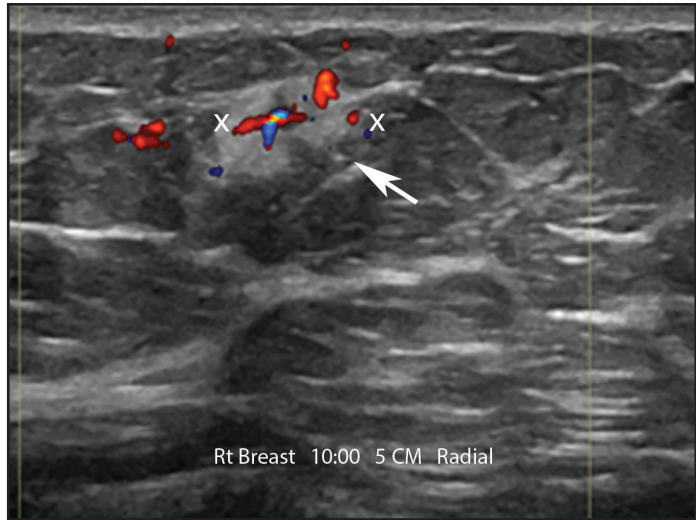


FIGURE 16. Angiosarcoma. A 56-year-old woman with prior right lumpectomy and radiation therapy reports new right breast skin discoloration. US image with color Doppler shows a hypervascular echogenic mass (arrow).

screen detected or palpable mass +/- nipple discharge.^{3,4} At US, it is classically a hypoechoic mass with non-circumscribed margins; however, in 2% of cases it may be hyperechoic.^{3,4,17} Echogenic breast masses on sonography with mammographic features such as interval development, spiculated margin, suspicious microcalcifications, or architectural distortion warrant biopsy.⁴

Some invasive breast cancers have a small hypoechoic central focus enclosed by a larger hyperechoic halo. Scanning only through the hyperechoic halo, and not recognizing the central nidus can cause such lesions to be mistaken for a purely echogenic, likely benign finding (Figure 11).¹⁸ Additionally, during core biopsy of an echogenic mass with posterior shadowing, care should be taken to biopsy the solid anterior echogenic component.

Invasive lobular carcinoma (ILC)

ILC is the second most common (10%) breast cancer.¹⁹ Histologically, it infiltrates along the ducts in single rows without a desmoplastic reaction.^{9,19} The common mammographic appearance is a spiculated mass or architectural distortion (Figure 12A), however ILC can be occult on MG. Features such as absence of a definable mass and hyper-

echogenicity are relatively frequent on ultrasound (Figure 12B).^{9,18,19}

Hyperechoic lesions are 10X more frequent in ILC, and metastases to the axillary nodes can also appear hyperechoic.^{9,16} The infiltrative spread of ILC results in more reflective surfaces for the ultrasound beam, the postulated cause of hyperechogenicity.¹⁹

Mucinous (colloid) carcinoma

Mucinous carcinoma is a rare breast malignancy, more common in older women.^{20,21,22} Histologically, it is subdivided into pure or mixed subtypes, depending on the mucin content. The pure subtype has a favorable prognosis with lower incidence of axillary metastasis.¹⁸ On mammography, mucinous carcinoma is usually a round or oval, dense circumscribed mass. Ultrasound typically shows an isoechoic or hypoechoic mass, but rarely can be hyperechoic.^{20,21,22} Ultrasound homogeneity favors a pure subtype, whereas heterogeneity is predictive of mixed subtype with less favorable histological grade (Figure 13).¹⁸

Lymphoma

Primary breast lymphoma, where the breast is the only organ affected, is rare.² The more common secondary

lymphoma is associated with extramammary involvement at diagnosis, and the most common subtype is diffuse B cell non-Hodgkin's lymphoma.⁹ Lymphoma usually affects older patients, presenting as a palpable mass, sometimes with skin changes, edema and palpable lymph nodes.^{9,18} Mammogram findings include a circumscribed noncalcified mass, multiple masses or diffuse increased density with skin thickening.^{9,18,23} On ultrasound, breast lymphomas are typically hypoechoic and frequently hypervascular, less often a mixed echogenic (Figure 14) or echogenic mass.^{9,18,23}

Metastasis

Metastases to the breast are rare, most commonly from melanoma, lung cancer, lymphoma and ovarian cancer.⁴ A typical presentation is fast growing, painless, palpable masses which can be bilateral.² Mammography usually shows single or multiple circumscribed masses.^{2,18} Ultrasound shows hypoechoic or rarely hyperechoic lesions.^{2,18}

An echogenic mass with internal vascularity requires biopsy, as more than half of breast lymphomas and the majority of melanoma metastases are hypervascular (Figure 15).⁴

Angiosarcoma

Angiosarcoma is an uncommon breast malignancy of endovascular origin with poor prognosis.^{24,25} There are two subtypes: primary, occurring sporadically in young women, and secondary, seen following breast cancer treatment in older women with prior history of radiation therapy or post-surgical lymphedema.^{2,24} Angiosarcomas present as palpable masses or skin discoloration which may be mistaken for bruising, delaying the diagnosis.²⁴ Ultrasound often shows single or multiple, hypervascular, circumscribed or ill-defined hypoechoic masses. However 44% of angiosarcomas can present as mixed echogenic or echogenic lesions (Figure 16).⁹

Conclusion

Hyperechoic breast lesions, although rare, are not all benign. Occasionally a breast malignancy can present as a hyperechoic mass. The worrisome features in a sonographically echogenic lesion are: irregular shape, non-circumscribed margin, and nonparallel orientation.¹⁶ The decision to biopsy should be based on the most suspicious US features, correlation with the mammographic appearance, and the clinical history. When used in conjunction, this knowledge can help the radiologist formulate an accurate differential diagnosis and management plan.

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