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Bright Is Not Always Better: A Pictorial Review of Hyperechoic Malignant Breast Masses

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Abstract

Hyperechogenic breast lesions are a relatively rare finding at breast ultrasonography and are traditionally thought to be benign. However, hyperechogenicity on the ultrasound alone does not provide enough evidence to rule out malignancy completely. We herein reported a short series of nine cases of echogenic malignant breast lesions, which include invasive ductal carcinoma, ductal carcinoma in situ, invasive lobular carcinoma, angiosarcoma, lymphoma, and metastasis to the breast. Echogenic breast lesions should be carefully evaluated and properly categorized based on any other suspicious sonographic characteristics and must be correlated with mammographic findings and clinical history to lower the threshold for biopsy and avoid delay in diagnosis.

Hyperechogenicity should not be considered as a characteristically benign feature and should not supersede the less specifically benign features of the same lesion on the other examination.

Keywords

- malignancy
- ultrasound
- hyperechoic

Introduction

According to the Breast Imaging Reporting & Data System (BI-RADS) atlas,[1] hyperechogenicity is defined as having increased echogenicity relative to fat or equal to fibroglandular tissue. Hyperechogenicity on breast ultrasound is attributed to the presence of compact adipocytes, dense fibrotic bands, and multiple vascular spaces and has a high negative predictive value for malignancy. Although extremely rare, hyperechoic breast malignancies do exist, and hence hyperechoic lesions should not be completely ignored without a careful search for any suspicious features. Heterogeneity in tumor cellularity, such as cribriform arrangement, solid nests, tubular formation, and a scirrhous pattern of neoplastic cells, results in increased echogenicity of the lesion.[2]

We describe the imaging features of malignant hyperechoic lesions in different cases and the features that prompted us to do their biopsy and thus achieve the correct diagnosis.

Illustrative Cases and Discussion

Most breast malignancies have a hypoechoic appearance on ultrasound. The occurrence of hyperechoic malignancies is in the scope of 0.4 to 2%.[3–5]

Differential diagnoses for malignant hyperechoic lesions include invasive lobular carcinoma (ILC), invasive ductal carcinoma (IDC), ductal carcinoma in situ (DCIS), metastasis to the breast, lymphoma, and sarcoma.

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Invasive Lobular Carcinoma

ILC is the second most common type of breast cancer after IDC.[6] A hypoechoic mass with posterior shadowing is the most prevalent sonographic appearance of an ILC. Additionally, other sonographic presentations include acoustic shadowing without any apparent mass and an ill-defined area of altered echotexture without discernible margins.[7] Less commonly, ILC may be present as a single or multiple well-circumscribed masses. Bilaterality and multiplicity are more common in ILC than in other subtypes of breast cancer.[6]

Rarely, ILC may present as a hyperechoic mass on ultrasound, which may be assigned a false benign diagnosis, especially if mammographic imaging findings are not very suspicious (►**Figs. 1**, **2**, and **3**). In their large series, Jones et al found that 5% of ILC lesions had a hyperechoic appearance.[6] Another study found that 1% of 69 ILC lesions were hyperechoic.[8]

The infiltrative nature of the tumor may explain the echogenic appearance of lobular carcinoma. ILC is composed of noncohesive cells that are arranged in linear rows and extend into adjacent breast parenchyma in a concentric ring pattern surrounding the ducts, which leads to the formation of multiple acoustic reflectors, giving the hyperechoic appearance on sonography.[9]

Invasive Ductal Carcinoma (IDC) and Ductal Carcinoma In Situ (DCIS)

Breast malignancies, regardless of histologic subtype, usually appear hypoechoic on ultrasonography. As compared to ILC, IDC less commonly shows hyperechogenicity on ultrasound. In their study, Skaane and Engedal found that 2% of IDCs were hyperechoic.[3]

It has been hypothesized that hyperechoic breast cancers reflect the heterogeneity of the tumor histology, such as cribriform arrangement, solid nests, tubular formation, and a scirrhous pattern of neoplastic cells.[10]

Hyperechoic IDCs usually harbor one or more suspicious sonographic characteristics such as irregular shape, non-circumscribed margins, nonparallel orientation, posterior acoustic shadowing, abundant vascularization, and the presence of a small central hypoechoic component. Hyperechoic invasive carcinomas and DCIS may also have corresponding alarming mammographic findings such as spiculated margins, architectural distortion, suspicious microcalcification, interval enlargement or new appearance, and lymphadenopathy.[11] But sometimes it may be associated with less suspicious findings, such as focal asymmetry (►**Figs. 4**, **5**, and **6**). Further assessment with contrast-enhanced magnetic resonance imaging (MRI) should be performed to characterize these lesions and evaluate the extent of the disease.

Hyperechoic invasive carcinomas should be evaluated by using the same suspicious sonographic characteristics that are used to assess hypoechoic breast masses and should be assigned an appropriate American College of Radiology Breast Imaging Reporting & Data System (ACR BI-RADS) category. Hyperechogenicity should not be seen as a definite benign feature and should not be used to supersede other suspicious imaging findings.

Lymphoma

Primary lymphoma of the breast is uncommon, accounting for less than 0.5% of all breast malignancies.[10] Breast lymphomas are categorized as primary (only the breast is afflicted) or secondary (at the time of diagnosis, accompanied by extramammary lymphomatous involvement). Diffuse B-cell lymphoma is the most common histologic subtype of breast lymphoma.[12] On ultrasound, breast lymphoma typically presents as single or multiple, oval, circumscribed, hypoechoic, vascular masses; however, they may exhibit mixed echogenic or completely hyperechoic echotexture (►**Fig. 7**).[13] Breast lymphoma's hyperechoic character is likely due to the tumor's high cellularity. The presence of posterior acoustic shadowing, which is often found in IDC, is not common with lymphoma.

Metastasis

Breast metastases may appear hyperechoic on ultrasonography (►**Fig. 8**). Primary tumors that metastasize to the breast include lung, ovarian, and melanoma.[13] Breast metastases are usually bilateral and multifocal, with an approximate incidence of 1.7 to 6.6%.[14] In addition to their rarity, breast metastases have distinct clinicopathologic traits.

Metastatic breast lesions frequently present as circumscribed masses. This may be the result of the development of metastases from a central core of lymphovascular invasion and the peripheral echogenic pattern has been linked to vascularity, hemorrhage, tumor cells, or adipose tissue depending on the primary finding.[15]

Angiosarcoma of the Breast

Breast angiosarcoma is an uncommon malignancy that often affects young women. It may develop sporadically or during breast-conserving treatment with radiation therapy. The typical presentation of angiosarcoma on ultrasound is a heterogeneous, hyperechoic, hypervascular mass (►**Fig. 9**).[16] Angiosarcoma appears as a hyperechogenic mass due to the presence of abnormal anastomotic vessels and clusters of spindle cells within the tumor.[10] In contrast to low-grade tumors, intermediate-grade and high-grade lesions contain areas of solid neoplastic vascular growth and necrosis, hemorrhage, and infarction.[16] On MRI, angiosarcomas have significant postcontrast enhancement with areas of hemorrhage and cystic cavities that represent venous lakes.[10]

Liposarcoma is an extremely rare kind of breast cancer that manifests as a hyperechoic breast mass on ultrasound. Hyperechogenicity is associated with fat content, but has not been observed in our series.[13] Liposarcomas can occur spontaneously in the stromal breast parenchyma or may arise in phyllodes tumor. Liposarcomas may present as solid

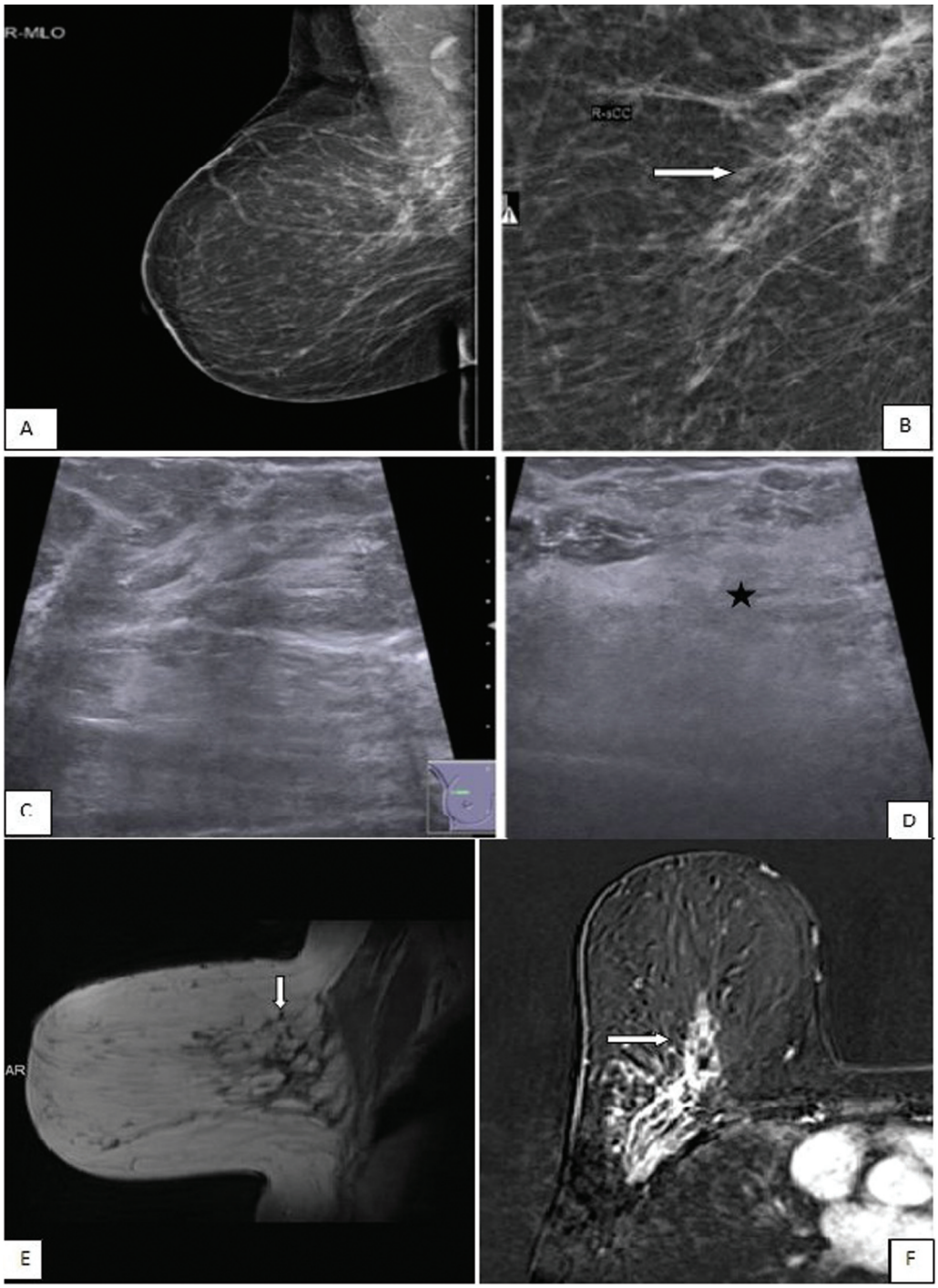

Fig. 1 (**A**) Screening right mediolateral oblique view of a 45-year-old female reveals focal asymmetry in the upper half of the right breast in form of multiple linear hyperdensities that persist on spot compression on craniocaudal view (**B**) (arrow). (**C, D**) A high-resolution ultrasound of the breast shows an ill-defined area of hyperechogenicity in the right upper outer quadrant (black asterisk). (**E**) Sagittal T1-weighted nonfat-suppressed magnetic resonance imaging (MRI) shows multiple linear hypointensities involving upper outer quadrant of right breast (arrow). (**F**) Contrast-enhanced MRI reveals a large area of heterogeneous, nonmass enhancement in regional distribution involving upper outer quadrant of right breast with linear extensions of enhancement (arrow) in the breast parenchyma and infiltration of the underlying pectoral muscles. Histopathology confirmed invasive lobular carcinoma (ILC). The multiple linear shadows on mammograms resembled the Red Indian file pattern or single file pattern of the ILC on histopathology.

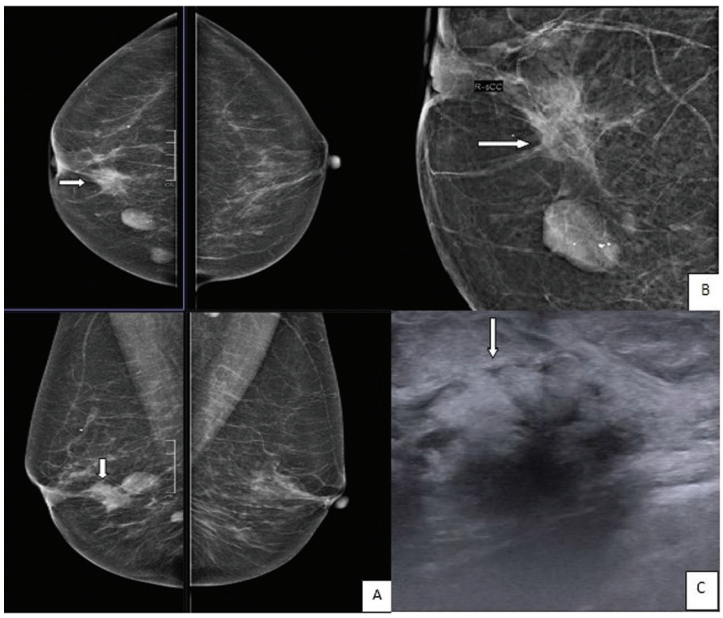

Fig. 2 A 58-year-old female patient presented with a blood-stained discharge from the nipple. (**A**) Mammograms (craniocaudal [CC] and mediolateral oblique views) reveal an irregular mass in the right retroareolar region (arrow) and two oval, circumscribed nodules, which were identified on ultrasound as BI-RADS -3 fibroadenomas. (**B**) Spot-compression CC view reveals irregular margins of the mass (arrow). (**C**) The ultrasound reveals a hyperechoic mass with an internal hypoechoic area and subtle posterior acoustic shadowing (arrow). However, on mammogram, the mass exhibited an irregular shape and subtle spiculations, hence it was biopsied. HPE, histopathological examination.

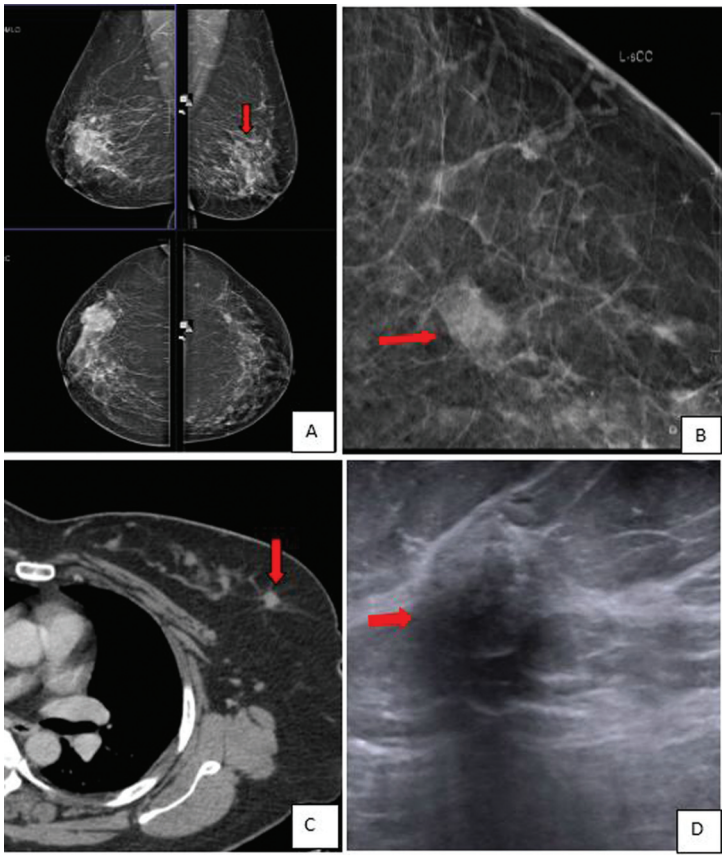

Fig. 3 A 52-year-old female presented with a right breast lump. (**A**) The mammograms (craniocaudal and mediolateral oblique views) reveal an irregular mass in the right breast and a small isodense nodule with subtle spiculation in the left breast (red arrows). (**B**) Computed tomography (CT) showed subtle spiculated margins. (**C**) Correlative ultrasound shows an irregular hyperechoic nodule with indistinct margins and posterior acoustic shadowing. Due to suspicious morphological features on mammography and CT, an ultrasound-guided biopsy was performed. Final histopathology revealed invasive lobular carcinoma.

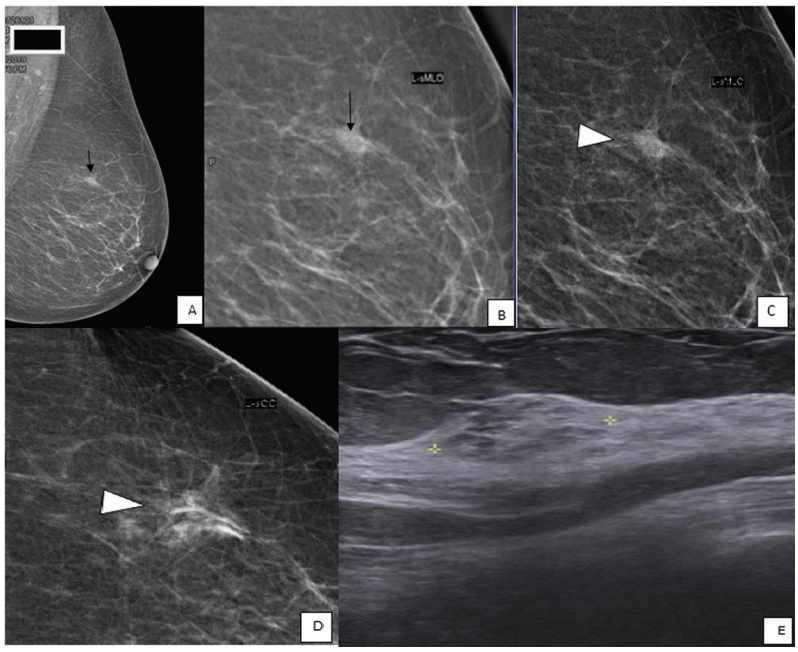

Fig. 4 A surveillance mammogram of a woman, previously treated for contralateral breast cancer. (**A**) mediolateral oblique view of the left breast reveals a small new focal asymmetry in the left breast upper half (line arrow) persisting on spot-compression view (**B**) with subtle indistinct margins (line arrow). A small amount of iodinated contrast was injected into it under ultrasound guidance and spot craniocaudal view obtained before (**C**) and after (**D**) the injection confirmed that this lesion was a true correlate of mammographic abnormality (arrowheads). Correlative ultrasound reveals a small hyperechoic area mimicking the normal fibroglandular tissue (**E**). Since it was an interval appearance in a high-risk patient, it was biopsied. HPE: invasive ductal carcinoma. In our experience, injecting iodinated contrast under ultrasound guidance into a doubtful area is a very useful method to confirm if it is a true correlate of the mammographic abnormality, as stereotactic biopsy is not widely available. However, this technique is not widely practiced or talked about.

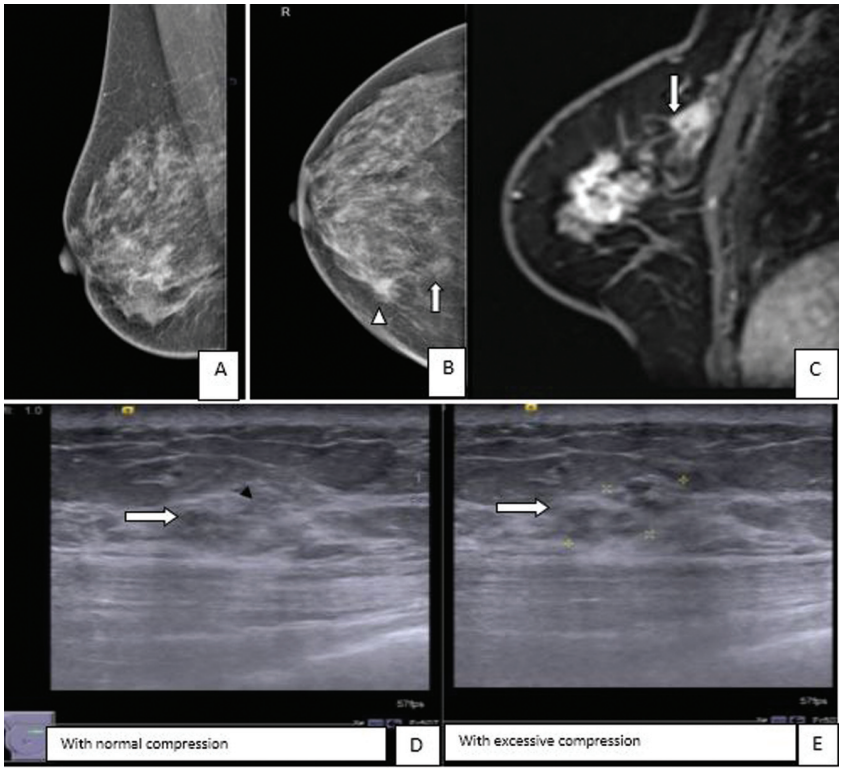

Fig. 5 Screening mammogram. (**A, B**) mediolateral oblique and craniocaudal views of a 55-year-old woman showing a spiculate mass in the upper half of the right breast (arrowhead) (*confirmed on ultrasound [US] but not shown*) and a subtle, smaller nodule posterior to it (white open arrows). (**C**) The contrast-enhanced magnetic resonance imaging of breast reveals a small additional enhancing mass in the right upper inner quadrant (white open arrow). (**D**) A second look at US revealed an ill-defined hyperechoic mass with areas resembling normal fibroglandular tissue. Lesion could be confidently identified, and margins could be visualized only after excessive compression of the probe (white open arrows in **D** and **E**). Histopathology revealed ductal carcinoma in situ.

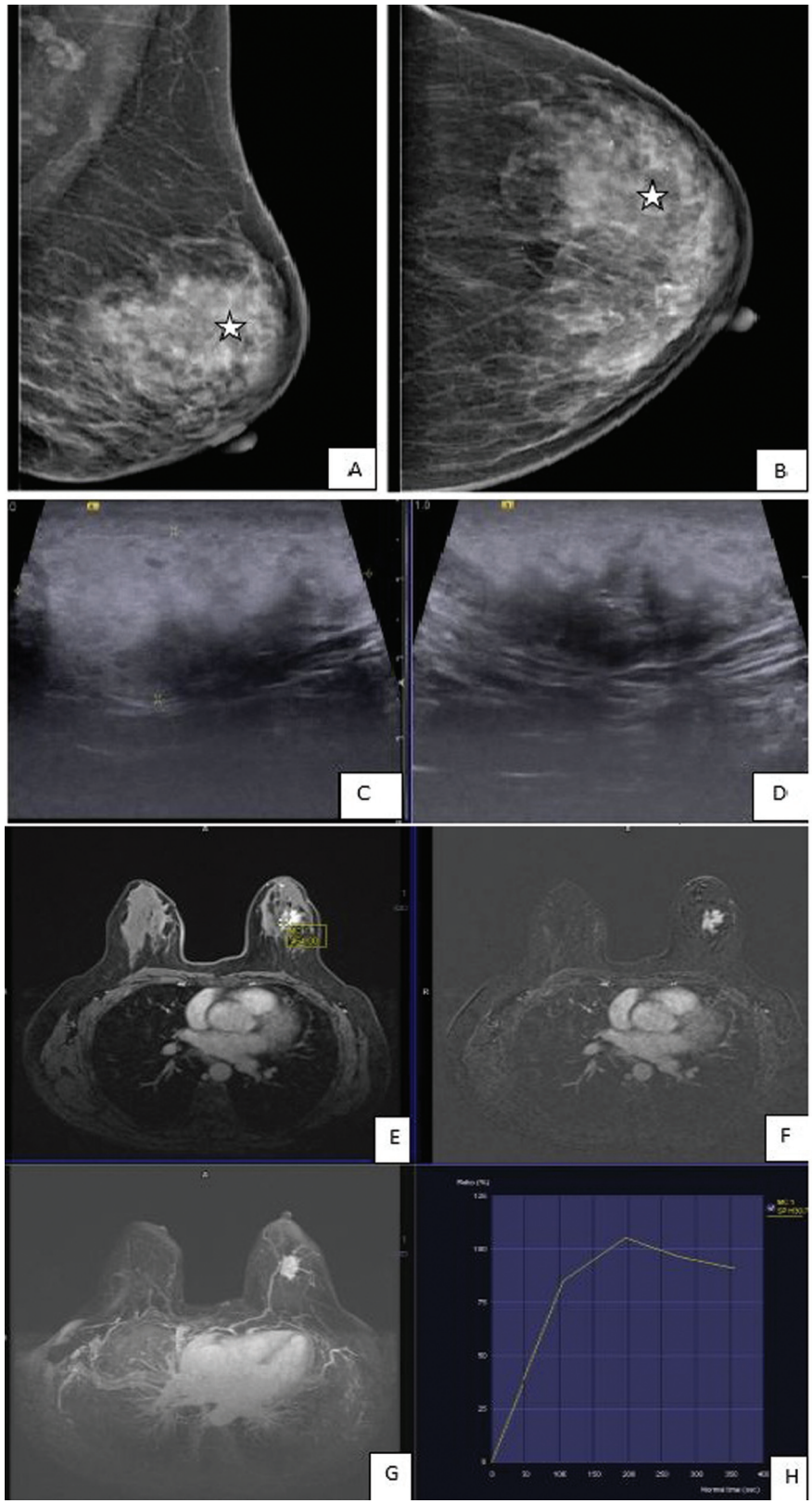

Fig. 6 A 57-year-old female presented with a palpable abnormality in her left breast. Mammogram of the left breast: (**A, B**) The craniocaudal and mediolateral oblique views reveal global asymmetry in the upper outer quadrant of the left breast (asterisks). (**C, D**) The ultrasound (US) reveals a large, ill-defined hyperechoic mass having a focal internal hypoechoic area with associated posterior acoustic shadowing. Contrast-enhanced magnetic resonance imaging (CEMRI) revealed an isoglandular mass (hamartoma) with minimal heterogeneous internal enhancement. (**E, F, G**) An irregular focal hyperenhancing area revealing washout kinetics is seen (**H**), corresponding to the area of shadowing on US. On account of posterior acoustic shadowing on US and suspicious findings on CEMRI, US-guided biopsy was performed. HPE: high-grade ductal carcinoma in situ with comedo necrosis.

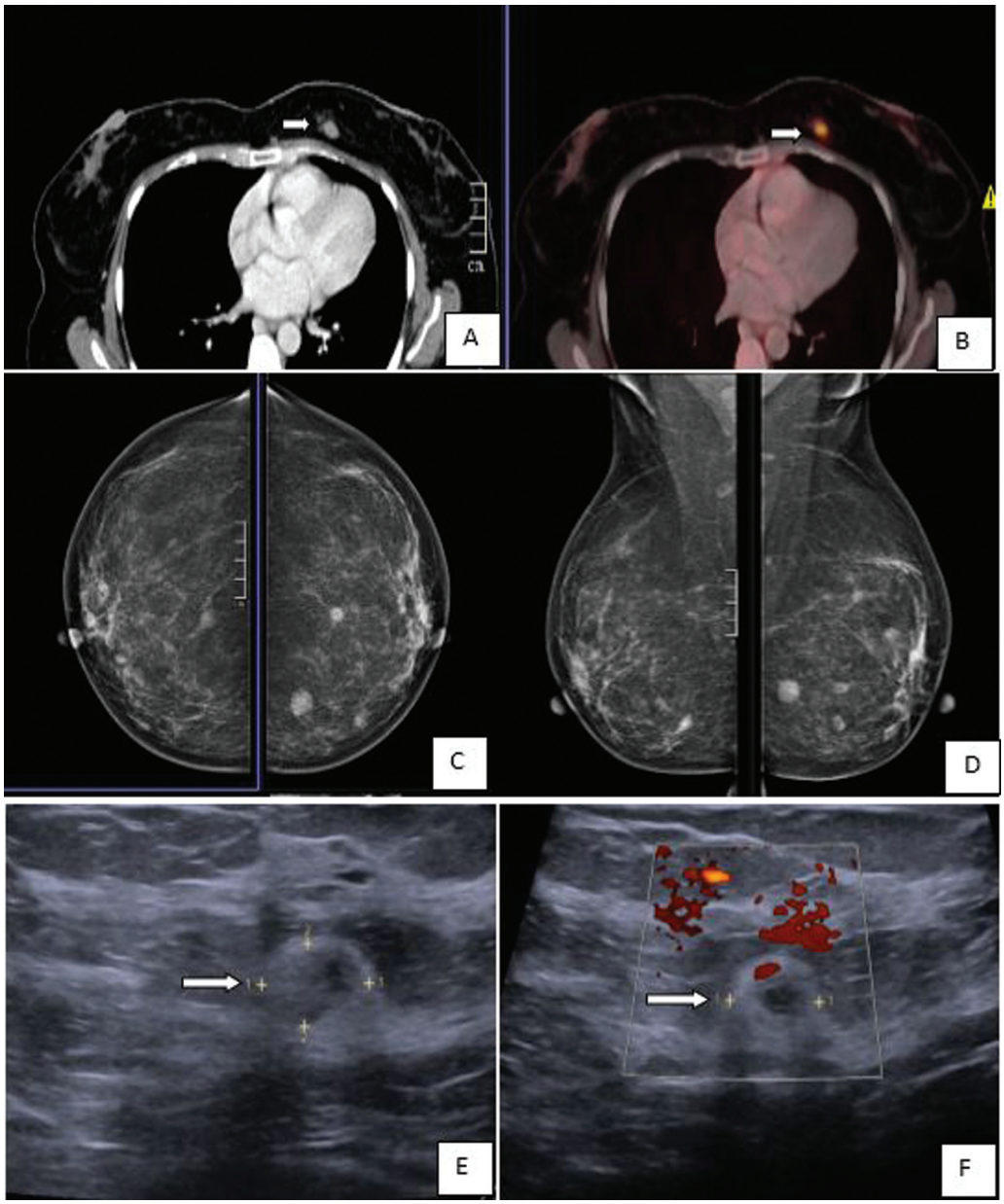

Fig. 7 A 40-year-old woman with known Burkitt's lymphoma. (**A, B**) Computed tomography (CT) chest and positron emission tomography-CT images reveal an fluorodeoxyglucose-avid nodule in the left breast (white open arrows). (**C, D**) The mammogram (mediolateral oblique and craniocaudal views) shows a few dense, rounded nodules in both breasts. (**E, F**) Ultrasound shows a well-defined hyperechoic mass with an eccentric hypoechoic area and internal vascularity (white open arrow). HPE, histopathological examination.

masses or as complex cystic and solid masses on ultrasonography.[10]

Malignant lesions are usually heterogeneous, revealing hypoechoic or isoechoic areas within a hyperechoic lesion; uniformly hyperechoic breast malignancies are exceedingly rare and seldom documented.[15] Hyperechoic malignant lesions reveal two predominant patterns: first, a hyperechoic rim with a hypoechoic center corresponding to a central tumor nidus with fibrosis and tumor infiltration at the margin; and second, a "dispersed pattern" where tumor cells and hyperechoic areas are scattered throughout the lesion.[15]

In contrast to invasive carcinomas, breast lymphoma and metastasis to the breast lack suspicious sonographic characteristics such as noncircumscribed margins and irregular shapes. However, lesions are usually hypervascular[12] and are usually picked up on positron emission tomography-computed tomography for the staging of primary cancers as avid lesions. The presence of internal vascularity in a hyperechoic lesion is suspicious and should warrant biopsy.

Hyperechoic lesions should be evaluated by using the same characteristics that are used to assess hypoechoic breast masses and should be assigned an appropriate ACR BI-RADS category.[17]

Digital breast tomosynthesis (DBT) improves characterization of masses by clarifying benign characteristics of the mass such as the well-defined margin, typical radiolucent halo, and central fat density, allowing for a more confident diagnosis of benignity. DBT can also detect subtle suspicious

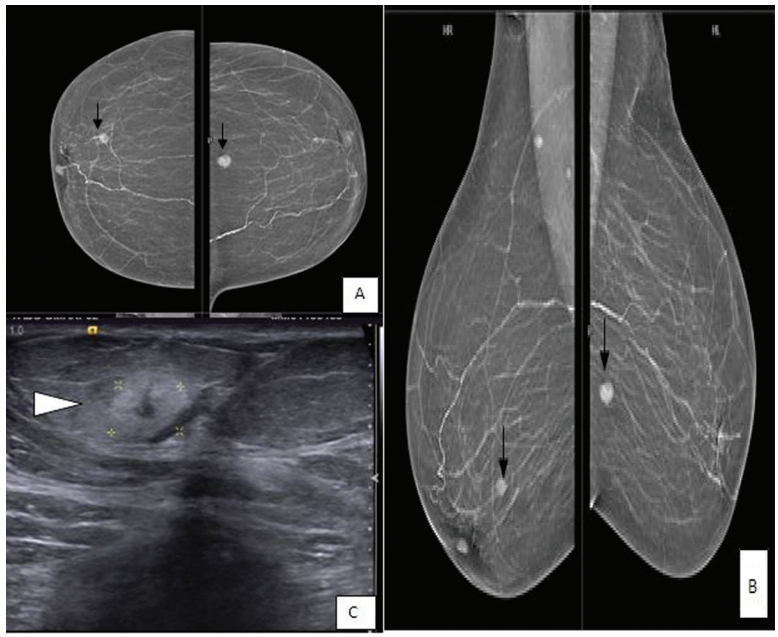

Fig. 8 Screening mammogram of a postmenopausal woman with primary lung malignancy. (**A, B**) Craniocaudal and mediolateral oblique views reveal two small, high-density nodules in bilateral breasts (line arrows). (**C**) The ultrasound revealed a well-defined hyperechoic mass with a small, central hypoechoic area (white arrowhead). HPE: metastases to the breast.

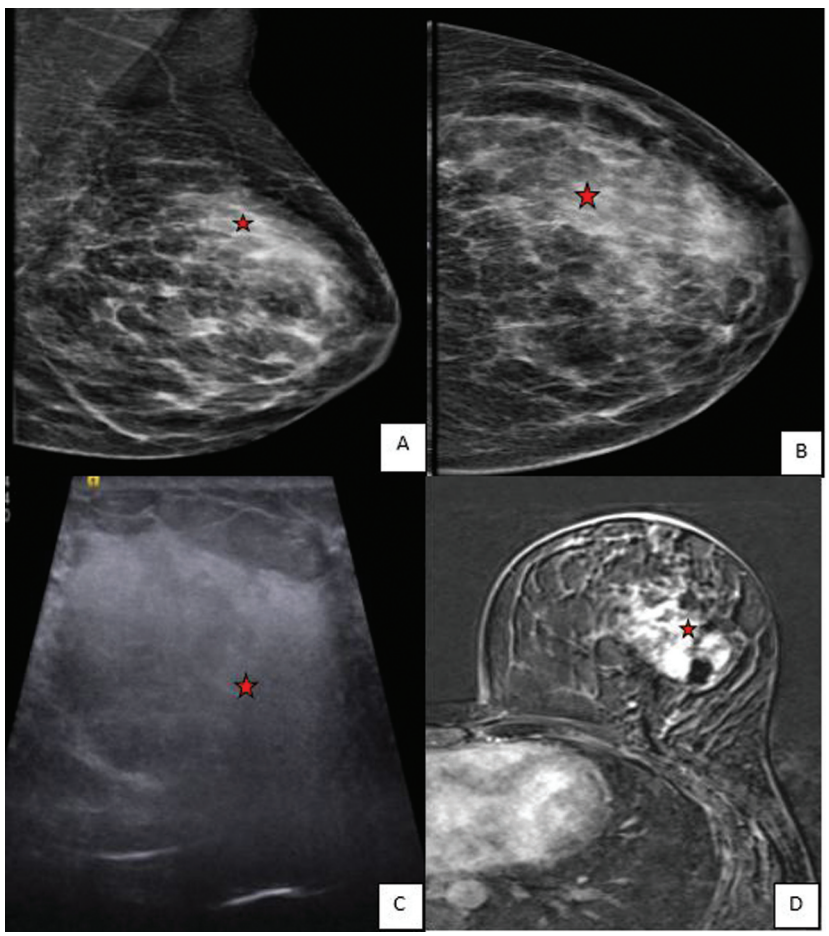

Fig. 9 A young female presented with a palpable left breast lump. (**A**) The mammogram (left mediolateral oblique and craniocaudal views) shows a large focal asymmetry in the upper outer quadrant of the left breast (red asterisk). (**B**) The ultrasound demonstrates a large hyperechoic mass in the left breast (red asterisk). (**C**) Contrast-enhanced magnetic resonance images show a large area of heterogeneous nonmass enhancement in the left breast (red asterisk). HPE: angiosarcoma.

findings such as an irregular shape, and indistinct or spiculated margins.[18–20]

Conclusion

Although the echo pattern assists in the evaluation of a breast lesion in conjunction with other imaging features, echogenicity alone has a low degree of specificity. A small percentage of breast cancers may present as hyperechoic lesions on ultrasound. A comprehensive ultrasound scan should be performed with a careful search for the presence of suspicious sonographic features such as nonparallel orientation, posterior shadowing, and irregular margins. The patient's demographics, mammographic findings, axillary lymphadenopathy, clinical history, and presence of interval change also must be taken into account.

Author Contributions

S.P. diagnosed cases, collected all images, searched literature, and prepared the manuscript. J.A. diagnosed cases, confirmed diagnosis, searched literature, and reviewed the manuscript. A.M. collected all images and searched literature.

Conflict of Interest

None declared.

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