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Beyond the breast: Mammographic manifestations of systemic disease

Veenu Singla, MD [a,*], Dollphy Garg, MD, DNB [a], Gopika Sri, MBBS [a], Aravind Sekar, MD [b], Amanjit Bal, MD [b], Divya Dahiya, MS [c], Rajender Kumar Basher, MD [d]

[a] Department of Radiodiagnosis, PGIMER, Chandigarh 160012, India
[b] Department of Histopathology, PGIMER, Chandigarh 160012, India
[c] Department of Surgery, PGIMER, Chandigarh 160012, India
[d] Department of Nuclear Medicine, PGIMER, Chandigarh 160012, India

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ABSTRACT

Mammography is traditionally regarded as a domain confined to the detection of breast malignancies; however, it can also serve as a mirror for diverse systemic, haematological, autoimmune, infectious, and metabolic diseases. Imaging manifestations may reveal distinctive pathognomonic features that directly suggest an underlying systemic disorder or provide subtle indirect clues that prompt timely multidisciplinary evaluation, thereby sparing patients from unnecessary procedures. In this comprehensive review, we present one of the most diverse compilations of extramammary and systemic disorders manifesting within the breast. Through multimodality imaging and clinico-pathological correlation, we illustrate entities ranging from tubercular mastitis, IgG4-related mastitis, breast lymphoma, breast metastases, to vasculitis, amyloidosis, diabetic mastopathy, and systemic failure states, including cardiac and renal disease. Mammography provides an underutilised opportunity to assess overall patient health, guide systemic illness workup, and aid in risk stratification for conditions such as cardiovascular disease or syndromic malignancy predisposition, in addition to cancer detection. By consolidating these entities into a single resource, this article aims to expand the interpretive lens of breast radiologists, improving diagnostic precision and enabling them to contribute decisively to multidisciplinary patient care.

Introduction

With the rising global burden of breast cancer, mammography has become an indispensable tool for early detection, treatment planning, and surveillance. However, the diagnostic potential of mammography extends far beyond detecting breast pathologies alone. The breast can act as a mirror of systemic health, with diverse extramammary diseases leaving detectable signatures on breast imaging. In clinical practice, mammography has repeatedly served as a sentinel, revealing manifestations of systemic, autoimmune, infectious, metabolic, and vascular disorders, thereby directing patients toward timely evaluation and appropriate multidisciplinary care.

For the radiologist, the responsibility is twofold: to recognize these conditions when they masquerade as malignancy—avoiding unnecessary biopsies and therapeutic missteps—and to appreciate their distinctive or even pathognomonic features that may provide the first clue to an underlying systemic disorder. For instance, cardiovascular disease may manifest as vascular calcifications predictive of atherosclerotic risk; connective tissue diseases such as systemic lupus erythematosus, dermatomyositis, polymyositis, rheumatoid arthritis, and systemic sclerosis may reveal bilateral axillary lymphadenopathy or stromal calcifications; while conditions like neurofibromatosis type 1 or filariasis display characteristic appearances readily identified on mammography. Conversely, disorders such as sarcoidosis and amyloidosis may closely resemble breast malignancy and demand histopathological confirmation.

A thorough diagnostic approach that integrates imaging findings with clinical and pathological correlation is essential for accurate interpretation and optimal patient care. In this review, we present a comprehensive overview of systemic diseases with breast manifestations, structured through a compartmental approach, to familiarise radiologists with their varied mammographic appearances and highlight the broader role of breast imaging as a window into systemic disease (Fig. 1). A pattern-based classification of systemic disorders according to their mammographic manifestations is summarized in Table 1.

* Corresponding author at: Department of Radiodiagnosis, PGIMER, Chandigarh-160012, India.
E-mail address: veenupgi@gmail.com (V. Singla).

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Cutaneous disease

Pseudoxanthoma elasticum

Pseudoxanthoma elasticum (PXE), or Grönblad–Strandberg syndrome, is a rare inherited disorder caused by pathogenic variants in the *ABCC6* gene (ATP-binding cassette subfamily C member 6), leading to progressive degeneration and calcification of elastic fibers.[1] The disease involves multiple systems: the skin (yellowish papules and plaques, typically in flexural areas), cardiovascular system (peripheral arterial disease, claudication, and myocardial infarction), gastrointestinal tract (upper GI bleeding from vascular fragility), and eyes (angioid streaks and optic disc drusen). Breast involvement is usually detected incidentally during screening mammography.[2] Mammographic findings are nonspecific and may include fine or coarse skin calcifications, microcalcifications within the parenchyma, vascular calcifications, and localised skin thickening—often most prominent in the axillary regions (Fig. 2). The calcifications are non-ductal in distribution and lack suspicious pleomorphic morphology, helping to distinguish them from malignant microcalcifications. Ultrasound is generally nonspecific and may demonstrate dermal or subdermal echogenic foci with posterior acoustic shadowing corresponding to calcified elastic fibers. In the absence of an associated mass or suspicious calcification morphology, these findings are typically categorized as BI-RADS 2. Histopathology shows clumped and calcified elastic fibers in the dermis and vessel walls. Management is symptomatic, supported by coordinated multidisciplinary specialists.

Neurofibromatosis 1

Neurofibromatosis type 1 (NF-1) or Von Recklinghausen disease is an autosomal dominant genetic disorder caused by a mutation in the NF-1 gene in the long arm of chromosome 17, which manifests as multiple, variable-sized, neurofibromas on the skin.[3] The neurofibromas may also arise from the skin of the breast and nipple, more frequently observed in the periareolar location. On mammography, multiple, well-circumscribed, oval or round masses are observed with otherwise normal surrounding breast parenchyma. Some masses, particularly those near the skin surface, are outlined by a thin line of air density, creating a halo. Ultrasound reveals hypoechoic circumscribed masses in the dermal or subdermal location with posterior acoustic enhancement (Fig. 3). Histology reveals bundles of spindle-shaped cells with bands of collagen and mucoid material. As routine excision of multiple cutaneous neurofibromas is not practical, management is usually symptom-driven or for cosmetic concerns. Radiologists should note the presence of numerous nodules and maintain awareness of the rare malignant potential of plexiform variants.[3-5] In the absence of atypical imaging features such as rapid growth, irregular margins, internal heterogeneity, or deep parenchymal involvement, these lesions are typically classified as BI-RADS 2. Any lesion demonstrating progressive enlargement, pain, or atypical imaging features warrants further evaluation and biopsy. The association between NF-1 and breast cancer emphasizes the importance of screening mammography in these patients.[4,5]

Necrobiotic Xanthogranuloma

Necrobiotic Xanthogranuloma (NXG) is a rare, chronic, non-Langerhans cell histiocytosis that typically affects elderly individuals and is strongly associated with monoclonal gammopathy (most often the IgG κ type).[6] Clinically, it presents with indurated yellowish nodules and plaques, most frequently in the periorbital region, causing ptosis, diplopia, or discomfort. Extracutaneous involvement may affect the lungs, heart, oropharynx, and, rarely, the breast. On mammography, breast involvement by NXG manifests as one or more irregular, high-density masses with indistinct or angular margins, closely mimicking primary breast carcinoma. Lesions may be focal or multifocal and are usually not associated with calcifications. Architectural distortion may be present when there is extensive stromal involvement. Ultrasound findings are nonspecific in the form of heterogeneously hypoechoic irregular masses. MRI may help define the extent of soft tissue involvement.[7] Given the malignant imaging appearance and lack of distinguishing benign features, breast lesions related to NXG are generally categorised as BI-RADS 4, necessitating histopathological confirmation. Biopsy reveals necrobiosis with granulomatous inflammation containing Touton-type giant cells and cholesterol clefts. Management includes administration of systemic immunosuppressive agents with local surgical excision or radiotherapy in selected cases.

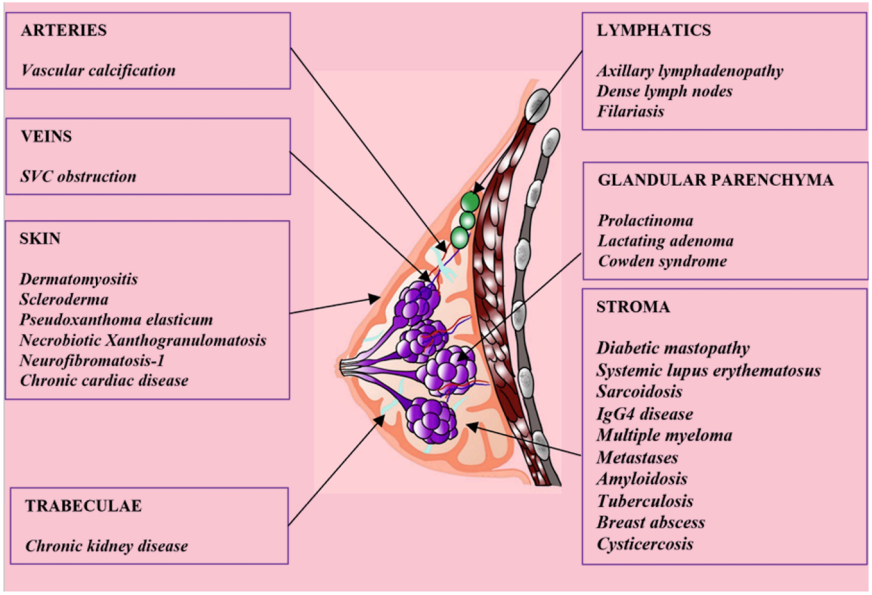

Fig. 1. Schematic illustration depicting systemic diseases affecting different breast compartments.

Systemic inflammatory disease

Systemic lupus erythematosus (SLE)

Lupus mastitis (LM) is an uncommon manifestation of lupus panniculitis, also known as lupus erythematosus profundus, characterised by chronic inflammation of subcutaneous fat.[8] Clinically, LM manifests as one or more tender subcutaneous nodules, occasionally progressing to ulceration and atrophic scarring. On mammography, lupus mastitis most commonly presents as an ill-defined mass, focal asymmetry, or architectural distortion, often without a discrete mass. Coarse or dystrophic calcifications may be present, particularly in chronic or recurrent cases, reflecting fat necrosis and fibrosis. Lesions may be unilateral or bilateral and may be associated with overlying skin thickening or retraction. Ultrasound can reveal hypoechoic, heterogeneous masses with indistinct margins, mimicking malignancy, fat necrosis, or diabetic mastopathy. Increased surrounding echogenicity of the subcutaneous fat may be seen due to an inflammatory change. Given its overlap with breast carcinoma and other inflammatory lesions, lupus mastitis is usually assigned a BI-RADS 4 category, and a core or excisional biopsy is essential for diagnosis. Immune complex deposition along vessel walls and dermo-epidermal junctions, lobular lymphocytic panniculitis, periductal lymphoplasmacytic infiltrates, and lymphocytic vasculitis are histological features. First-line therapy consists of corticosteroids or antimalarial agents, with surgery being reserved for refractory cases. With appropriate immunosuppression, LM usually results in a good response, although recurrences are not uncommon.[9]

Dermatomyositis/Polymyositis

Dermatomyositis (DM) is an idiopathic inflammatory myopathy characterised by immune-mediated damage to the skin, striated muscle, and connective tissue. Soft tissue calcification (calcinosis) is a recognised complication, particularly in juvenile DM, with a reported prevalence ranging from 10–40%.[10] Calcinosis represents dystrophic calcium deposition in damaged tissues. Adult-onset DM is frequently associated with malignancy, most notably breast, ovarian, lung, and gastrointestinal cancers, and often manifests as a paraneoplastic syndrome.[11] Histopathology typically reveals perifascicular atrophy, perimysial and perivascular lymphocytic infiltrates, and dermal mucin deposition. On mammography, dermatomyositis most characteristically demonstrates calcinosis within the breast, appearing as non-ductal, coarse, sheet-like calcifications predominantly involving the subcutaneous fat. These calcifications may be localised or diffuse and can coalesce to form plaque-like or mass-like deposits. Mammographic calcifications in DM must be distinguished from benign etiologies such as fat necrosis or systemic sclerosis and suspicious pleomorphic calcifications seen in malignancy. Ultrasound may reveal hyperechoic foci with posterior shadowing, whereas CT can better delineate deep fascial or muscular calcifications. In the absence of suspicious mass, architectural distortion, or pleomorphic calcifications, calcinosis related to dermatomyositis is usually assessed as BI-RADS 2. Management of calcinosis remains challenging: while systemic corticosteroids and disease-modifying agents (e.g., methotrexate, mycophenolate) control myositis activity, established calcifications often persist.[12] Recognition of breast calcifications or masses in a patient with known DM should prompt the radiologist to highlight the increased cancer risk and recommend age-appropriate systemic screening.

Scleroderma

Scleroderma is an autoimmune connective tissue disease that

Table 1
A pattern-based classification of systemic disorders according to their mammographic manifestations.

DOMINANT MAMMOGRAPHIC PATTERN	KEY IMAGING CHARACTERISTICS	REPRESENTATIVE SYSTEMIC DISEASES	TYPICAL BI-RADS ASSESSMENT	CLINICAL IMPLICATION
A. CALCIFICATION				
DIFFUSE / LINEAR VASCULAR CALCIFICATIONS	Parallel 'railroad-track' arterial calcifications	Breast arterial calcification, chronic kidney disease, diabetes mellitus, pseudoxanthoma elasticum	BI-RADS 2	Marker of systemic vascular disease rather than breast malignancy
COARSE / SHEET-LIKE STROMAL OR DERMAL CALCIFICATIONS	Large, confluent, non-ductal calcifications	Dermatomyositis, systemic sclerosis (scleroderma), morphoea	BI-RADS 2	Dystrophic calcinosis related to connective tissue disease
MICROCALCIFICATIONS	Amorphous or pleomorphic calcifications	Amyloidosis, metastatic sarcoidosis	BI-RADS 4	Primary breast malignancy mimic requiring tissue diagnosis
SERPIGINOUS / NON-DUCTAL CALCIFICATIONS	Curvilinear or wandering calcifications	Filariasis, cysticercosis	BI-RADS 2	Suggests parasitic etiology
B. MASSES				
MULTIPLE CIRCUMSCRIBED MASSES (BILATERAL/ MULTIFOCAL)	Oval or round, well-defined, high-density masses	Neurofibromatosis type 1, metastases, lymphoma, multiple myeloma, Cowden syndrome	BI-RADS 2–4	Suggests systemic or syndromic disease, especially when bilateral
IRREGULAR / SPICULATED MASSES	Ill-defined margins, architectural distortion	IgG4-related mastitis, sarcoidosis, amyloidosis, lupus mastitis	BI-RADS 4–5	High-risk malignancy mimic; biopsy essential
C. ARCHITECTURAL DISTORTION				
ARCHITECTURAL DISTORTION (WITH OR WITHOUT MASS)	Parenchymal distortion without a discrete mass, radiating lines, focal retraction	Sarcoidosis, lupus mastitis, sclerosing mastitis, diabetic mastopathy, tuberculosis (sclerosing form)	BI-RADS 4	High-risk malignancy mimic; biopsy required for diagnosis
D. SKIN THICKENING AND EDEMA				
DIFFUSE OR FOCAL BREAST EDEMA WITH SKIN THICKENING	Trabecular thickening, increased density, peau d'orange	Congestive heart failure, chronic kidney disease, hepatic failure, inflammatory breast cancer, mastitis	BI-RADS 2 (if bilateral) BI-RADS 4 (if unilateral)	Bilaterality favors systemic cause, Unilateral warrant biopsy to rule out inflammatory breast cancer
E. VASCULAR				
VENOUS ENGORGEMENT / PROMINENT SUPERFICIAL VEINS	Dilated, tortuous tubular structures	Superior vena cava obstruction, congestive heart failure, antiphospholipid syndrome	BI-RADS 2	Reflects altered central venous hemodynamics
F. AXILLARY LYMPHNODES				
AXILLARY LYMPHADENOPATHY	Enlarged nodes with or without loss of fatty hilum	Tuberculosis, lymphoma, sarcoidosis, metastatic disease, vaccination-related	BI-RADS 2–4	Systemic correlation required before breast intervention
CALCIFIED AXILLARY LYMPH NODES	Coarse, eggshell or punctate metallic calcifications	Tuberculosis, gold chrysotherapy, tattoo pigment	BI-RADS 2	Sequelae of prior systemic or iatrogenic exposure

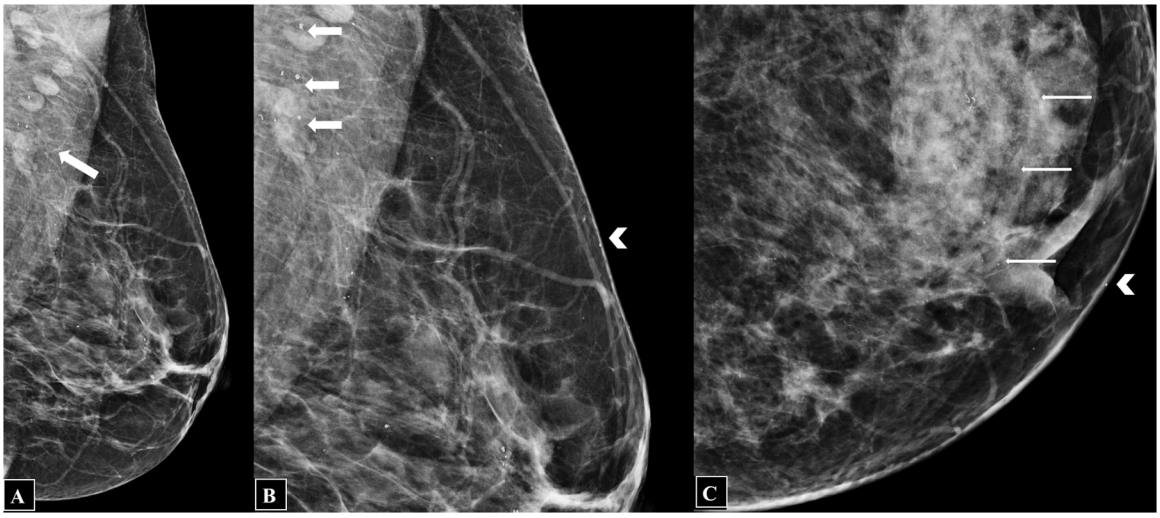

Fig. 2. Pseudoxanthoma elasticum in a 62-year-old woman undergoing screening mammography. Mediolateral oblique (A) magnified mediolateral oblique (B), and magnified craniocaudal (C) views of the left breast demonstrate scattered punctate calcifications in the axilla (solid white arrows), parenchyma (thin white arrows), and skin (solid arrowhead).

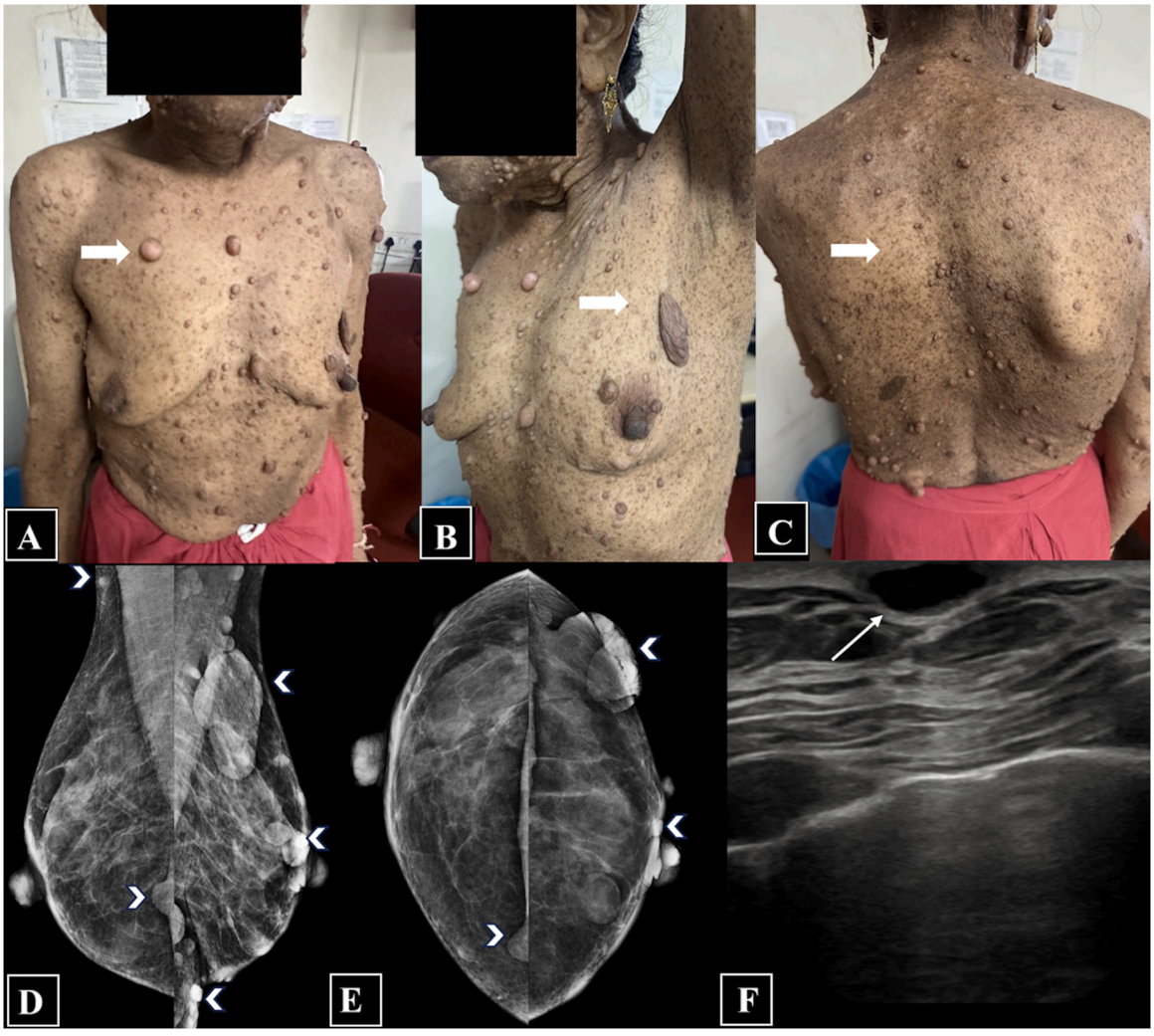

Fig. 3. Neurofibromatosis type 1 in a 51-year-old woman. Clinical photographs (A–C) demonstrate numerous cutaneous nodules (thick white arrows). Bilateral mediolateral oblique (D) and craniocaudal (E) mammograms reveal multiple, well-circumscribed, skin-based nodules (white arrowheads). Targeted ultrasonography (F) shows corresponding hypoechoic nodules within the dermis (thin white arrow).

comprises three subsets: localized scleroderma, also known as morphoea, characterized by fibrosis and calcification of the skin and subcutaneous tissues, presenting as calcinosis; limited cutaneous systemic sclerosis; and diffuse systemic sclerosis, with multisystem involvement.[13] Unlike systemic scleroderma, morphoea does not involve visceral organs and may present in various forms—deep, linear, generalized, or plaque morphoea. Plaque morphoea, the most common variant, manifests as indurated skin over the trunk or limbs due to excessive collagen deposition and may be accompanied by calcifications. In systemic sclerosis, calcinosis is a key manifestation and is proposed to be due to vascular ischemia and repeated microtrauma, resulting in tissue hypoxia and ischemia. Histopathology confirms the diagnosis, revealing dermal and subcutaneous calcium deposits within the fibrotic stroma. Imaging plays a key role in detecting and characterizing calcinosis. On mammography, scleroderma most commonly manifests as diffuse or focal coarse calcifications involving the skin, subcutaneous tissues, and superficial breast parenchyma. The calcifications are typically non-ductal, irregular, and extensive, often distributed along the skin surface or subcutaneous plane rather than within the glandular tissue (Fig. 4). Ultrasound reveals hyperechoic foci with posterior acoustic shadowing, whereas CT and MRI are valuable for assessing deep tissue extension, inflammatory changes, or associated myopathy.[14] Typical calcific patterns related to scleroderma, in the absence of suspicious mass, architectural distortion, or malignant-type microcalcifications, are generally categorised as BI-RADS 2. Importantly, atypical or rapidly developing breast calcifications in patients with scleroderma should raise suspicion for coexistent malignancy, warranting upgrading BI-RADS category and biopsy.

Sarcoidosis

Sarcoidosis is a multisystem granulomatous disorder of unknown etiology that most commonly affects the lungs, intrathoracic lymph nodes, skin, eyes, and joints. Isolated breast sarcoidosis is rare, accounting for ~1% of cases.[15] Clinically, patients may present with a palpable lump, localized tenderness, or incidental findings on screening mammography. Mammographic appearances are variable and include an irregular mass, focal asymmetry, or architectural distortion, which are often indistinguishable from those of breast carcinoma (Fig. 5). Ultrasound may reveal an ill-defined, hypoechoic mass or parenchymal distortion, whereas MRI may reveal an irregular enhancing lesion with nonspecific kinetics. Given the frequent overlap with breast carcinoma on imaging, sarcoidosis-related breast lesions are usually assigned a BI-RADS 4 category, and image-guided core needle biopsy is recommended for definitive diagnosis. Histopathology characteristically demonstrates noncaseating epithelioid granulomas without evidence of infection. The differential diagnosis includes granulomatous mastitis, tuberculous mastitis, fungal infections, and autoimmune diseases such as Wegener's granulomatosis. Systemic corticosteroids remain the mainstay of treatment; methotrexate or other immunosuppressants are used in steroid-refractory cases. Surgery is rarely required and is reserved for persistent symptomatic masses or cases of diagnostic uncertainty.

IgG4 disease

IgG4-related breast disease is a rare manifestation of IgG4 disease, which is a chronic immune-mediated fibroinflammatory condition with multisystemic IgG4-positive plasma cell infiltration. It is characterized by dense lymphoplasmacytic infiltrates, storiform fibrosis, obliterative phlebitis, elevated serum IgG4 and multiorgan involvement in the pancreas, salivary glands, orbits, kidneys, lungs, retroperitoneum and, occasionally, the breast.[16] In the breast it manifests as IgG4-related mastopathy, sclerosing mastitis, and inflammatory pseudotumors. Clinically, patients might present with unilateral or bilateral palpable lumps that are firm and painless, with axillary lymphadenopathy. Mammography reveals irregular, spiculated, ill-defined masses closely resembling carcinoma. Masses may be solitary or multiple, and can involve one or both breasts. Calcifications are uncommon.[17] Sonography reveals hypoechoic, ill-defined masses scattered throughout the breast. These lesions are nearly always reported as BI-RADS category 4 and are biopsied (Fig. 6); and once the diagnosis is established histologically, the patients are put on oral corticosteroid therapy.

Vascular disease

Cardiovascular disease

Breast arterial calcification (BAC) is frequently observed as an incidental finding on screening mammograms, particularly in older women, with a prevalence of approximately 12%-23%.[18] It represents calcification involving the media of small mammary arteries and arterioles, also referred to as Monckeberg medial sclerosis. BAC is now increasingly recognized as a potential marker of systemic cardiovascular risk, including coronary artery disease, stroke, and heart failure. Factors such as age, parity, diabetes, and high cholesterol levels have been linked to

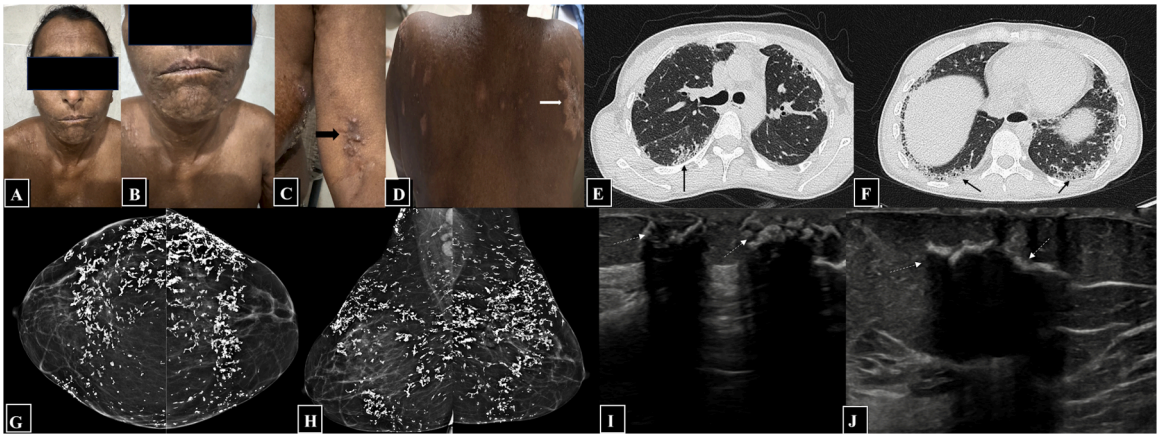

Fig. 4. Scleroderma in a 54-year-old woman. Clinical photographs showing frontal (A) and close-up (B) views of the face, the forearm (C) (black solid arrow), and the upper back (D) (white solid arrow) showing sclerotic plaques with overlying skin tightening and altered pigmentation. Axial high-resolution computed tomography (HRCT) images of the thorax (E, F) show peripheral, basal subpleural opacities with honeycombing (thin black arrows). Mammography images in the craniocaudal (CC) (G) and mediolateral oblique (MLO) views (H) of both breasts show diffuse skin and parenchymal calcifications. Targeted ultrasound images of bilateral breasts (I, J) show calcified foci in the breasts with posterior acoustic shadowing.

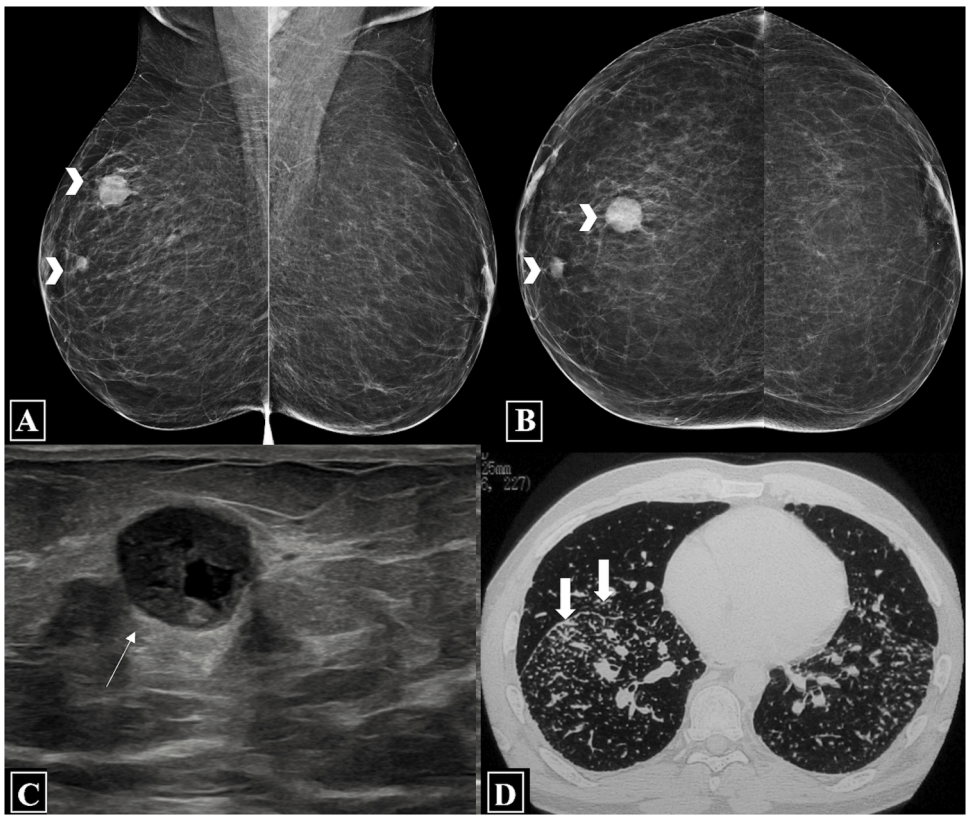

Fig. 5. Sarcoidosis in a 46-year-old woman confirmed with endobronchial ultrasound-guided biopsy. Bilateral mediolateral oblique (A) and craniocaudal (B) mammograms demonstrate two circumscribed, round, equal-density masses in the upper outer quadrant of the right breast (white arrowheads). Targeted ultrasonography (C) revealed a well-defined hypoechoic mass with an internal anechoic area due to necrosis. Axial high-resolution computed tomography (HRCT) of the chest (D) revealed perifissural and subpleural nodules with a classic perilymphatic distribution (white solid arrows).

its presence.[19] On mammography, BAC typically appears as linear or curvilinear, parallel calcifications resembling 'railroad tracks', reflecting calcified arterial walls (Fig. 7). Recognition of their vascular distribution and characteristic morphology allows confident differentiation from ductal calcifications related to malignancy. Breast arterial calcifications are benign findings and are appropriately categorised as BI-RADS 2. The presence of BAC in women under 50 years of age should prompt consideration of early vascular disease and associated conditions, such as hypertension or chronic kidney disease. The use of automated detection and quantification via artificial intelligence may further increase its utility in the development of cardiovascular risk models.[20] Current consensus encourages opportunistic reporting of BAC in mammography, with referral for cardiovascular risk assessment.[19]

Altered venous hemodynamics

Bilateral venous engorgement often indicates compromised venous return to heart, as seen in conditions like congestive heart failure or superior vena cava (SVC) obstruction. Central venous congestion may also present incidentally as bilateral breast varices on mammogram. On mammography, venous engorgement typically presents as enlarged, dilated, superficially located tubular structures (Fig. 8).

Additional secondary causes include pregnancy and post breast augmentation surgeries. In suspected cases, a clinical radiologist should recommend prompt evaluation for assessment of intrathoracic malignancy or central venous stenosis with a preliminary chest radiography followed by cross sectional imaging being deemed necessary.

Unilateral venous engorgement is less frequently encountered and usually results from localized venous congestion near or beyond the brachiocephalic-SVC junction, in which case it is important to consider the possibility of upper limb hemodialysis access-induced venous stenosis, which results in thrombosis following repeated cannulations.[21] Over time, collateral venous networks—including the azygos, intercostal, mediastinal, and internal thoracic veins—may form to compensate for the obstruction, with their extent reflecting the chronicity and severity of the condition (Fig. 9).

A separate yet related entity is Mondor's disease, which is a superficial venous thrombophlebitis in the breast that can be triggered by trauma, inflammation or systemic hypercoagulable states. Clinically, it manifests as localized pain, redness and a palpable subcutaneous cord-like structure that may accentuate with arm movement. Mammography reveals tubular, dilated, linear densities, representing the thrombosed and inflamed superficial vein. Doppler studies depict a dilated beaded venous channel with echogenic intraluminal contents, non-compressibility, and no flow in the vein (Fig.10). Detecting these findings on imaging also warrants ruling out underlying breast malignancy or systemic malignancies that may result in hypercoagulability.[22] If unrelated to malignancy, the condition usually self-resolves in 8 weeks, with treatment mostly focused on symptomatic relief.

In the absence of associated suspicious breast findings, venous engorgement related to systemic or physiologic causes is typically categorized as BI-RADS 2.

Vasculitis

Breast involvement in systemic vasculitides such as giant cell arteritis (GCA), polyarteritis nodosa (PAN), and granulomatosis with polyangiitis (GPA) is rare but clinically significant. GCA primarily affects postmenopausal women, who often present with painful breast lumps, localized erythema, or tenderness, and in some cases, may mimic inflammatory breast cancer. Imaging is usually inconclusive, although ultrasound may occasionally reveal a "halo sign" due to hypoechoic

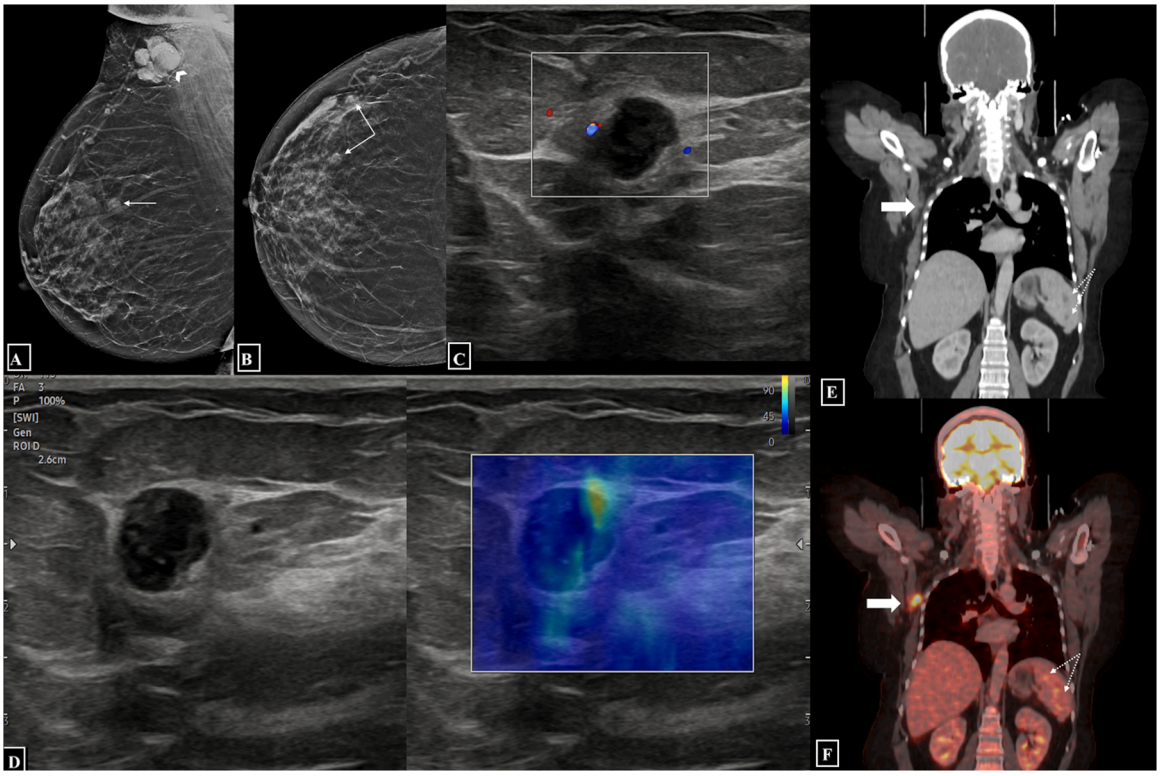

Fig. 6. IgG4 disease in a 34-year-old female with a history of autoimmune pancreatitis who presented with right mastalgia. Mammography of the right breast in mediolateral oblique (MLO) (A) and craniocaudal (CC) (B) views showing a few equal-density masses in the upper outer quadrant (thin white arrows) with axillary lymphadenopathy (white arrowhead). Targeted ultrasound (C) revealed hypoechoic irregular masses with peripheral vascularity. Real-time ultrasound elastography (D) revealed low stiffness. F-18 Fluorodeoxyglucose positron emission computed tomography (FDG-18 PET CT) (E, F) showing avid nodules in the spleen (white dashed arrow) and avid right axillary lymph nodes (thick white arrow). Biopsy of the breast mass revealed dense lymphoplasmacytic infiltrates with storiform fibrosis, which was consistent with IgG4-related mastitis.

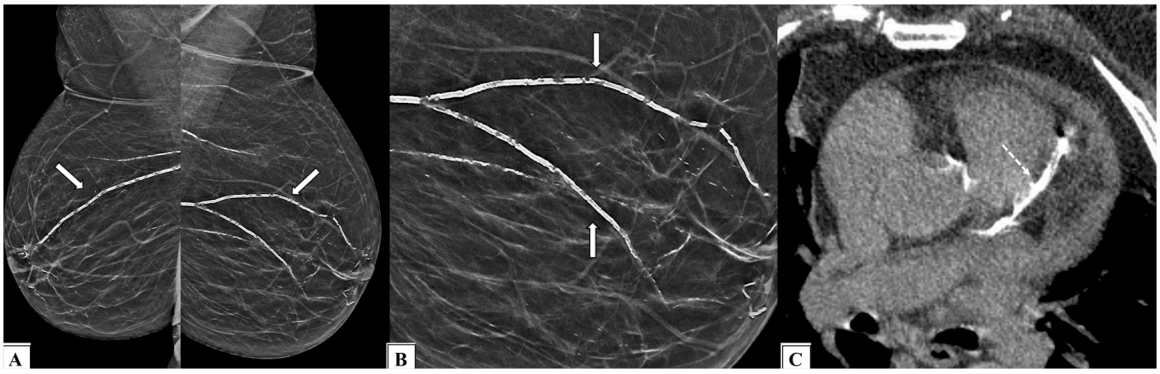

Fig. 7. Cardiovascular disease in a 73-year-old woman undergoing screening mammography. Bilateral mediolateral oblique mammograms (A) and magnified view (B) demonstrate dense vascular calcifications (white block arrows). Axial non-contrast chest CT (C) revealed diffuse calcification of the left main coronary artery and left anterior descending artery (white dashed arrow).

vessel wall thickening. PAN can present as a localized or systemic disease involving the breast, clinically resembling malignancy or infections such as mastitis. Imaging findings are subtle; mammography may show ill-defined densities or occasionally arterial calcifications (Fig. 11). Histology reveals segmental transmural inflammation, fibrinoid necrosis, leukocytoclasis, and disruption of the elastic lamina. GPA may manifest as breast masses, abscesses, or ulcerations and can present as a primary or systemic feature. Histopathology is needed for confirmation and shows giant cell infiltration, fragmentation of the elastica, and intimal proliferation.

Across these entities, imaging findings are nonspecific and often misinterpreted as carcinoma, leading to unnecessary surgical intervention. Mammography and ultrasound have low sensitivity for vasculitis, with nodular lesions easily misread as malignancies.[23] Histopathology remains the diagnostic gold standard, aided by vessel-specific stains such as SMA, CD31, and elastic fiber stains to differentiate it from nonpuerperal mastitis, which lacks vascular involvement. Other differentials include sarcoidosis, tuberculosis, fungal infections, and Mondor's disease. Treatment depends on the disease subtype and extent. GCA often responds well to corticosteroids alone, whereas PAN and GPA typically require combined immunosuppressive therapy.[24] The prognosis varies; localized disease has better outcomes, whereas systemic involvement, particularly of vital organs such as the kidneys or heart, can lead to poorer prognoses. As

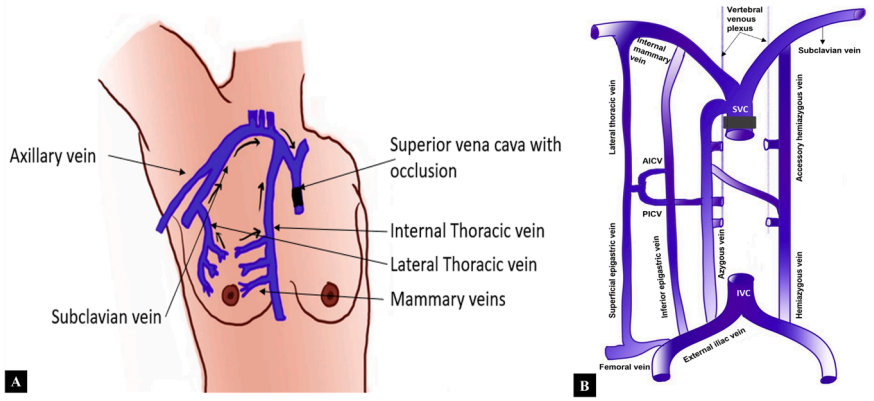

Fig. 8. (A) Diagram showing venous engorgement in superior vena cava obstruction. The mammary veins and lateral thoracic veins, as well as the internal thoracic veins, draining into the superior vena cava, are distended. (B) Diagrammatic representation of major collateral pathways involved in superior vena cava obstruction.

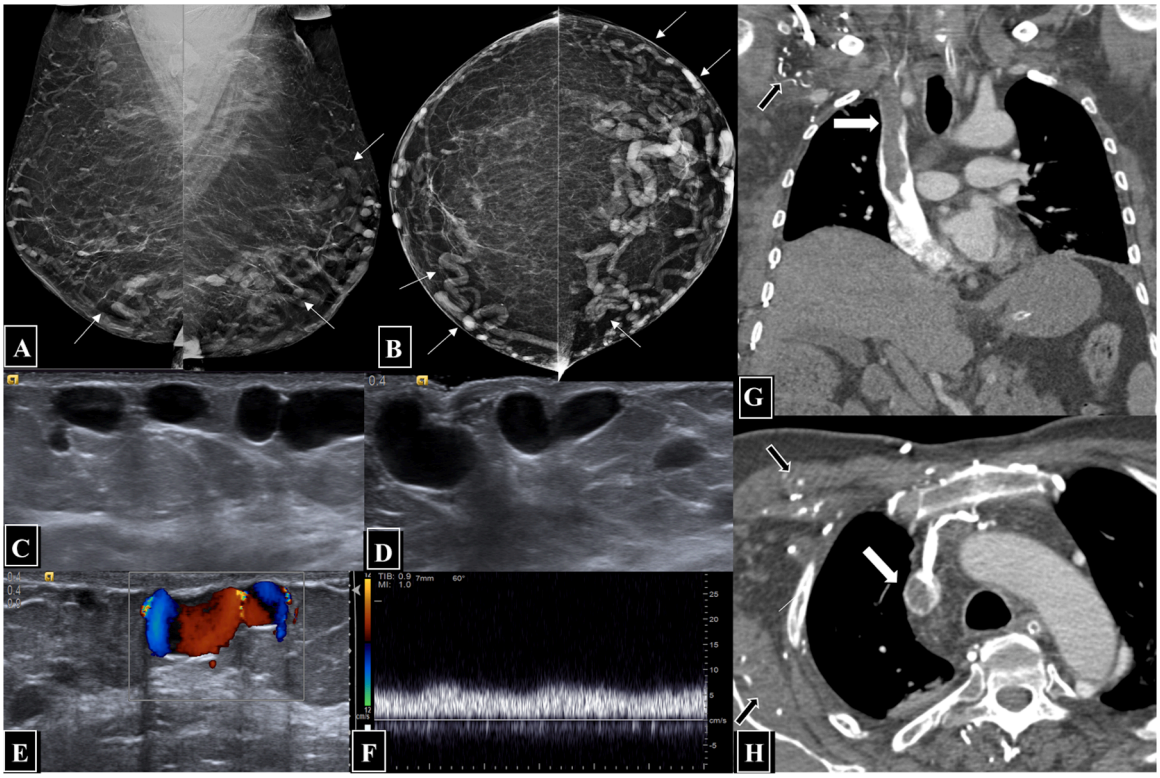

Fig. 9. Antiphospholipid antibody syndrome in a 32-year-old female presenting with bilateral breast discomfort due to engorged breast veins. Bilateral mediolateral oblique (A) and craniocaudal (B) mammograms demonstrate tortuous, dilated veins in both breasts (thin white arrows). Grayscale (C, D) and color Doppler (E) ultrasound images reveal dilated venous channels, with the Doppler waveform confirming venous flow (F). Coronal (G) and axial (H) contrast-enhanced CT images showing a hypodense filling defect within the superior vena cava (white block arrow) and multiple small, opacified collateral channels along the chest wall (black solid arrows).

vasculitides may mimic inflammatory breast cancer or infectious mastitis, early and accurate differentiation is critical for appropriate management.

Lymphatic disease

Axillary lymphadenopathy

Axillary lymphadenopathy may serve as a surrogate for underlying mammary or non-mammary malignancies as well as several nonspecific systemic conditions. It is important to correlate laterality, associated breast findings, and systemic history to narrow the differential.

Unilateral axillary lymphadenopathy:

1) **Malignancies:** Most commonly secondary to ipsilateral breast carcinoma or rarely due to metastases from non-mammary primaries.
2) **Infections:** Localized bacterial mastitis, cat-scratch disease (*Bartonella henselae*), and fungal infections.
3) **Other causes:** Postvaccination, reactive nodes also may be present secondary to recent upper limb surgery or trauma.

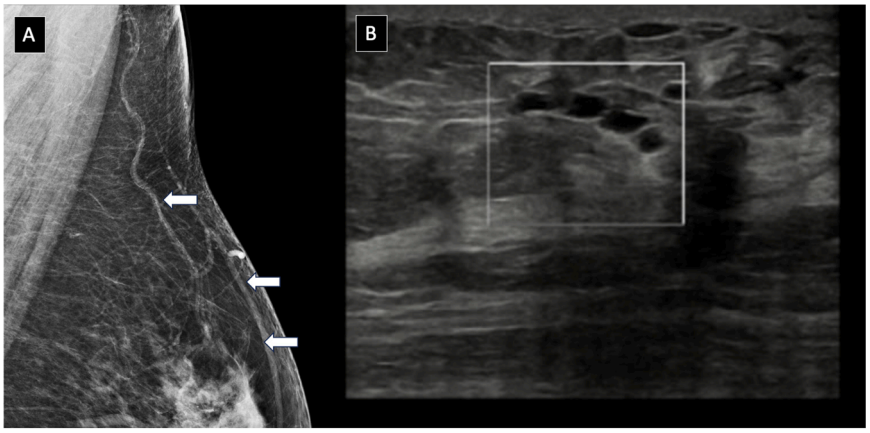

Fig. 10. Mammographic and sonographic findings in Mondor's disease in a 43-year-old woman presenting with a painful, cord-like induration in the outer quadrant of the left breast. (A) Mediolateral oblique (MLO) mammogram shows a superficial, tubular, beaded density (white arrows) extending vertically along the subcutaneous plane of the breast. (B) Targeted ultrasound at the site of palpable tenderness demonstrates a superficial, tubular, non-compressible, anechoic-to-hypoechoic structure with absence of internal vascular flow on Doppler, confirming superficial thrombophlebitis of the subcutaneous vein — findings diagnostic of Mondor's disease.

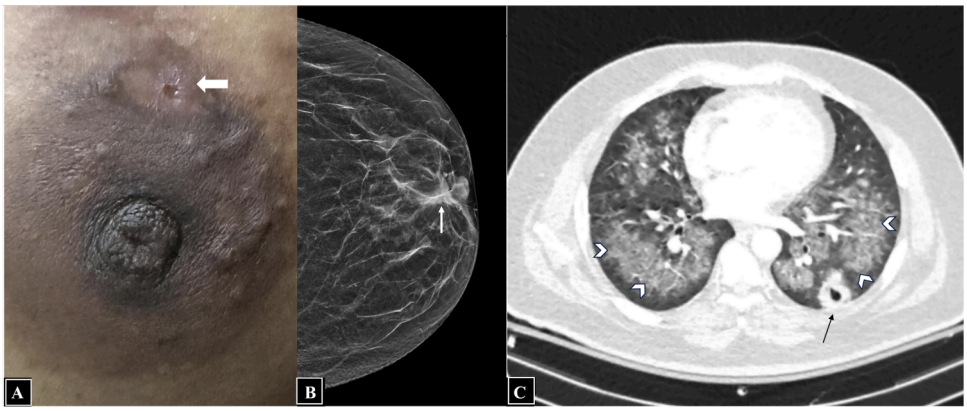

Fig. 11. Granulomatosis with polyangiitis in a 34-year-old female on treatment. Clinical photograph of the left breast (A) demonstrating skin ulceration along the superior aspect of the left nipple–areolar complex (white block arrow). Mammography in the craniocaudal (CC) view (B) shows focal asymmetry in the retroareolar region of the left breast (white arrow). High-resolution computed tomography (HRCT) of the chest in axial section (C) revealed a thick-walled cavitary lesion in the posterior segment of the left lower lobe (thin black arrow), associated with patchy bilateral ground–glass attenuation (white arrowheads) and interlobular septal thickening, consistent with diffuse alveolar hemorrhages suggestive of active vasculitis-related pulmonary involvement.

Bilateral axillary lymphadenopathy

1) **Lymphoproliferative disorders:** Hodgkin and non-Hodgkin lymphoma often present with massive, bilateral nodal enlargement.
2) **Systemic infections:** Tuberculosis, HIV, viral mononucleosis, and other chronic infections.
3) **Granulomatous diseases:** Sarcoidosis, fungal infections, and some autoimmune conditions.[25]
4) **Connective tissue diseases:** Systemic lupus erythematosus, rheumatoid arthritis, and other vascular disorders associated with collagen.[12]

Mammography reveals enlarged lymph nodes in the mediolateral oblique (MLO) view which may have loss of normal fatty hilum, loss of normal reniform shape and increased size and density (Fig. 12). Ultrasound plays an important role in differentiating reactive and malignant lymph nodes. Malignant nodes tend to have asymmetric cortical thickening (>3 mm), round shapes (increased short-axis diameter), eccentric or absent hilum, abnormal vascularity (prominent capsular vessels, neovascularisation), and high-resistance Doppler waveforms. Reactive nodes usually maintain an oval shape and a central fatty hilum with a symmetric cortex.[26] In patients with recent vaccination, short-term follow-up may suffice; in those on immune checkpoint inhibitors, bilateral PET-avid adenopathy may reflect sarcoid-like reaction rather than progression. Nodes with atypical morphology, discordant with history, warrant biopsy, ideally with lymphoma protocol handling when appropriate. Bilateral axillary lymph nodes without suspicious breast findings and a known infective or primary systemic cause are usually categorised as BI-RADS 2. Unilateral axillary lymphadenopathy without a known systemic cause is categorised as BI-RADS 4, warranting tissue sampling.

Dense lymph nodes

Calcified axillary lymph nodes may represent multiple underlying mammary and extra mammary conditions. Metastatic calcified lymphadenopathy results from malignancies such as mucinous carcinomas of the ovary, colon, and breast; medullary thyroid carcinoma; and osteogenic sarcomas. Coarse calcifications can be observed in granulomatous diseases (Fig. 13). Parenteral gold chrysotherapy, which has been used in the past for conditions such as rheumatoid arthritis, Still's disease, lupus and pemphigus, results in punctate deposits in normal axillary lymph nodes due to the accumulation of gold salts (Fig. 14). Extensive arm tattoos may also result in the deposition of dye within normal lymph

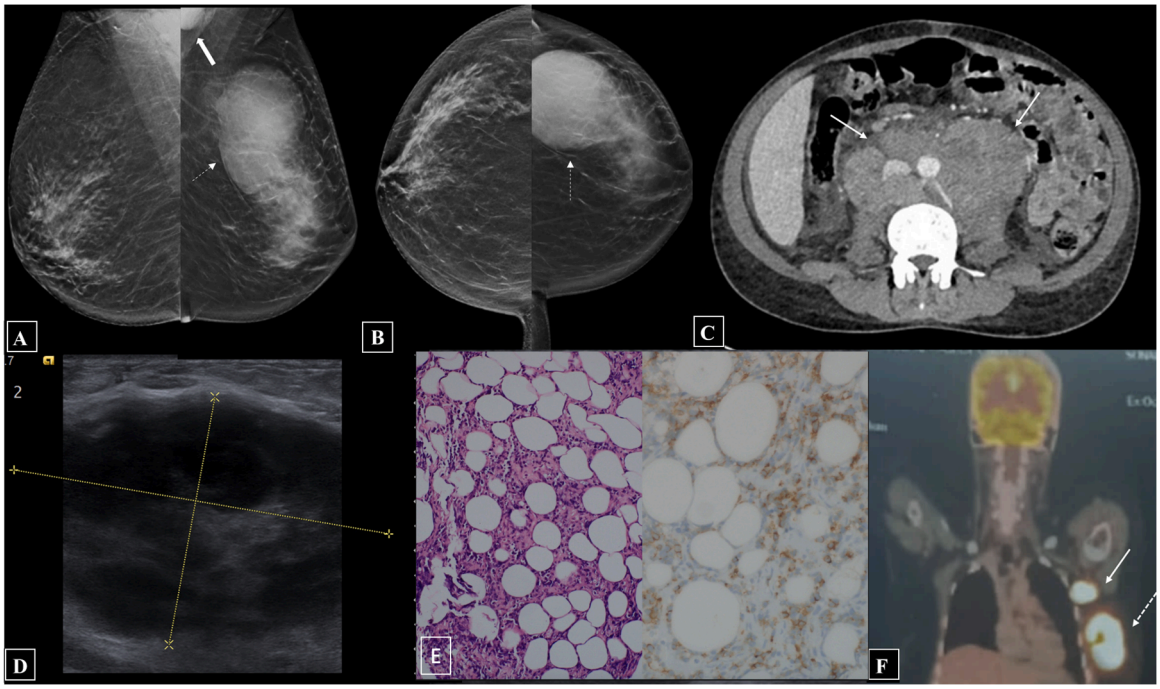

Fig. 12. Metastatic lymphoma in a 64-year-old female presenting with a left breast lump. Mammography in the mediolateral oblique (A) and craniocaudal (B) views demonstrated a large, high-density, well-circumscribed mass in the left breast (white dashed arrows). Enlarged axillary nodes can also be seen in the left axilla. Contrast-enhanced computed tomography (CECT) of the abdomen (C) revealed bulky, homogeneously enlarged retroperitoneal lymph nodes (white thin arrows). (D) Targeted ultrasound of the left breast shows a large, oval, circumscribed, hypoechoic mass. (E) Histopathology showing diffuse infiltration of atypical lymphoid cells with a high nuclear-to-cytoplasmic ratio and scant cytoplasm (H&E, × 200). Immunohistochemistry shows membranous CD20 positivity, confirming infiltration by B-cell lymphoma. (F) F-18 fluorodeoxyglucose Positron Emission Computed Tomography (FDG-18 PET CT) shows an avid left breast mass (white dashed arrow) and axillary lymph node (white thin arrow).

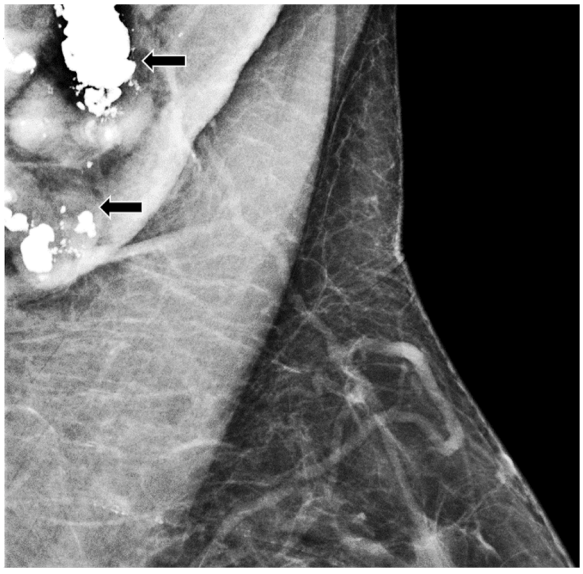

Fig. 13. A 54-year-old female with a past history of pulmonary tuberculosis, post completion of antitubercular therapy (ATT). Mammography of the left axilla revealed multiple, densely calcified lymph nodes (black solid arrow), consistent with sequelae of prior granulomatous infection.

nodes.[27] Coarse or eggshell calcifications favor benign prior granulomatous disease, while punctate metallic densities may indicate prior chrysotherapy or tattoo pigment. In contrast, fine pleomorphic calcifications within nodes should raise suspicion for metastatic mucinous or ovarian/thyroid carcinoma. Radiologists should apply a pattern-based approach and recommend biopsy when morphology is indeterminate.

Endocrinopathy

Diabetic mastopathy

Diabetic mastopathy is an uncommon, benign fibroinflammatory breast pathology that occurs in premenopausal women with chronic insulin-dependent type 1 diabetes mellitus and, occasionally, type 2 diabetes mellitus. Hyperglycemia results in the accumulation of advanced glycation end products (AGEs) within the extracellular matrix, which act as neoantigens, triggering an immune response characterized by the proliferation of B-cell lymphocytes and the production of autoantibodies.[28] In early stages, only subtle periductal mononuclear infiltrates may be present, potentially providing an incidental clue to underlying diabetes in breast biopsy samples. Notably, this condition is often associated with other autoimmune disorders, particularly Hashimoto thyroiditis, suggesting broader immune dysregulation. Clinically, it appears as one or more hard, painless, mobile breast masses that may be unilateral or bilateral, solitary or multiple, and often located in the subareolar region. Despite its benign nature, diabetic mastopathy can closely resemble breast carcinoma both clinically and radiologically.[29] On mammography, the breast usually appears diffusely dense, which limits visualization of a discrete mass and may show only asymmetric densities or architectural distortion (Fig. 15). Ultrasonography frequently reveals irregular, hypoechoic masses with marked posterior acoustic shadowing—features that are highly suggestive of malignancy. Magnetic resonance imaging has not demonstrated a diagnostic value in this condition, often showing variable findings such as diffuse and rapid enhancement, similar to malignancy. Given the malignant-appearing sonographic features and lack of specific benign imaging characteristics, lesions suspected to represent diabetic mastopathy are typically assigned a BI-RADS 4 category, and core needle biopsy is required for definitive diagnosis. Histopathology demonstrates dense fibrosis and B-cell lymphocytic infiltrate surrounding the ducts, lobules, and vessels.

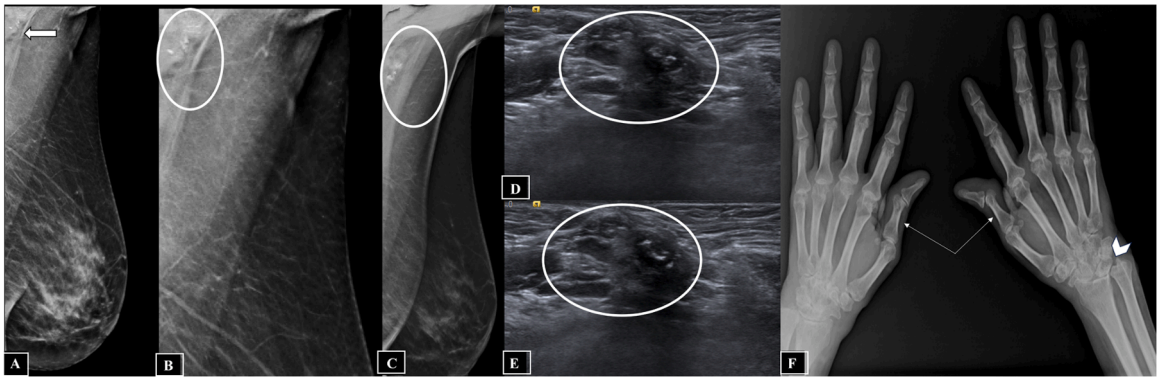

Fig. 14. A 67-year-old female undergoing screening mammography who was a known case of rheumatoid arthritis and had a history of gold chrysotherapy. The mediolateral oblique (MLO) (A) magnified (B), and axillary (C) views demonstrate multiple punctate high-density foci within axillary lymph nodes (white solid arrow, white circle). Targeted ultrasound (D, E) reveals corresponding hyperechoic punctate foci within hypoechoic lymph nodes, suggestive of gold deposits (white circle). Anteroposterior radiographs of both hands and wrists (F) show left scapholunate dislocation (white arrowhead), joint space narrowing at the wrists, juxta-articular osteopenia involving the metacarpophalangeal joints, and "hitchhiker's thumb" deformity (thin white arrows).

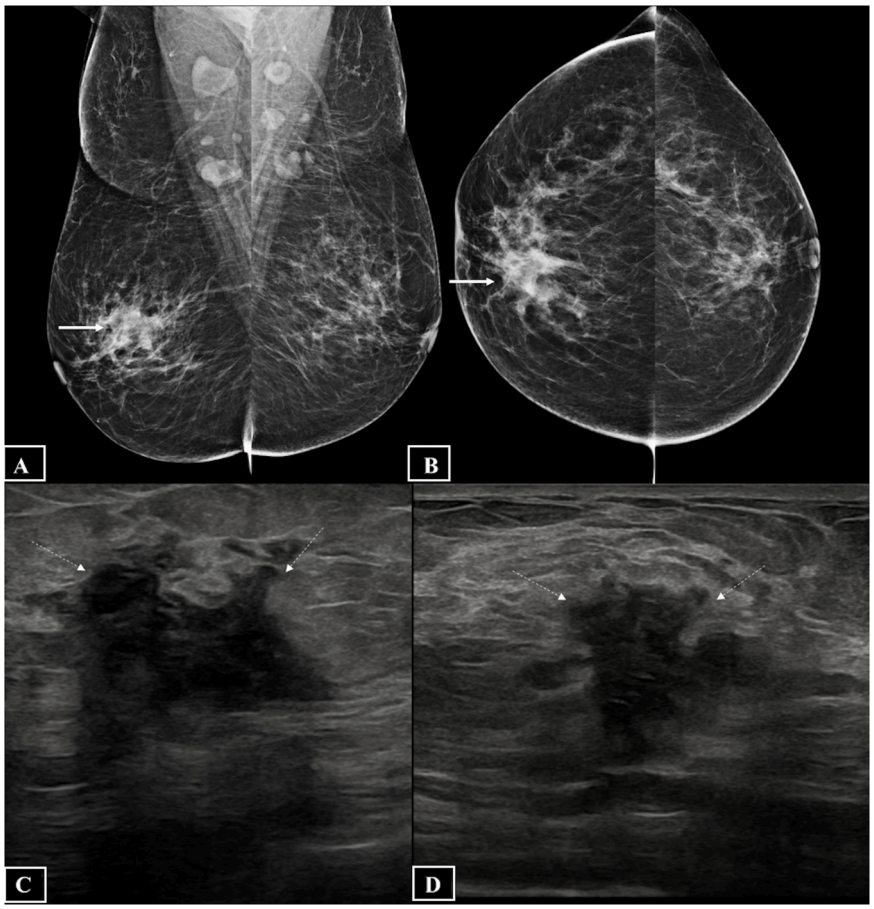

Fig. 15. Diabetic mastopathy in a 52-year-old woman with uncontrolled type II diabetes mellitus. Mammography in the mediolateral oblique (MLO) (A) and craniocaudal (CC) (B) views demonstrating focal asymmetry in the central region of the right breast (thin white arrow). Targeted ultrasound (C, D) revealed an irregular, hypoechoic mass with posterior acoustic shadowing (white dotted arrows), consistent with the imaging features of diabetic mastopathy. Ultrasound-guided core needle biopsy of the mass revealed B-cell lymphocytic infiltration and dense fibrosis, which was consistent with diabetic mastopathy.

Excision is rarely necessary unless malignancy cannot be excluded. There is no known risk of malignant transformation and no established preventive strategies. Although lesions may spontaneously regress, recurrence is not uncommon. Importantly, awareness of this entity among clinicians and radiologists is essential to prevent misdiagnosis and unnecessary surgical procedures.

Prolactinoma

Prolactin is a known functional regulator of the breast, orchestrating the proliferation and differentiation of the mammary epithelium and stimulating lactation. Hyperprolactinemia induced by prolactin-secreting pituitary micro- and macroadenomas results in a bidirectional effect on breast tumorigenesis.[30] A few case reports have

substantiated the association of prolactinomas with ER+ carcinomas of the breast. Interestingly, breast cancer progression appears to occur when prolactin levels are elevated but remain below a certain threshold, whereas higher concentrations may inhibit tumor growth.[31] The other associated finding in the breast of patients with hyperprolactinaemic conditions is a galactocele. This occurs due to the obstruction of lactiferous ducts and retrograde stagnation of milk and secretions, resulting in duct dilatation and retention of cysts. Clinically, the patient presents with a lump in the breast. On mammography, galactocele manifests as round or oval, well-circumscribed, equal- or low-density masses (pseudolipoma), with occasional fat-fluid levels. Correlational sonography reveals cystic/solid-cystic or purely solid masses. In a few cases, complicated cysts are seen with layering depicting anechoic deep component and superficial echogenic component, with no internal vascularity, resulting in the appearance of an acorn cap, described as the "acorn cyst" sign.[32] Typical imaging features of a galactocele are categorised as BI-RADS 2. Spontaneous resolution is expected in most cases. In symptomatic cases, fine needle aspiration is indicated, which reveals milky fluid.

Another manifestation of hyperprolactinemia is granulomatous mastitis (GM), which has also been linked to autoimmune disorders, pregnancy, lactation and oral contraceptive intake. Patients present with painful masses associated with nipple retraction and fistulae. Mammography commonly reveals focal asymmetry, skin thickening, irregular masses and axillary lymphadenopathy. Ultrasonography depicts hypoechoic masses having insinuating tubular extensions into the surrounding breast parenchyma with associated sinus tracts, abscesses and skin thickening (Fig. 16).[33] Granulomatous mastitis is generally assigned a BI-RADS 4 category, necessitating tissue diagnosis. Histopathology demonstrates sterile noncaseating granulomas which are lobulocentric. Nearly half of the patients with GM resolve within 14 months, the non-resolving ones can be treated with antibiotics, oral or intralesional corticosteroids. For relapsing or poorly responding cases, methotrexate, bromocriptine or surgical excision may be considered.

Lactating adenoma

Lactating adenoma is a benign breast lesion that commonly occurs in pregnant or lactating women. Its pathogenesis remains debated, with some authors proposing a de novo neoplastic origin, whereas others suggest that it represents hormonally induced transformation of preexisting lesions such as fibroadenoma, tubular adenoma, or lobular hyperplasia.[34] Clinically, it usually presents as a painless, mobile mass in the third trimester or during lactation, occasionally appearing bilaterally or in ectopic breast tissue along the milk line. On ultrasound, it typically appears as a well-circumscribed, homogeneously hypoechoic mass with posterior acoustic enhancement, although these features may be variable. Mammography is rarely needed during pregnancy but may be performed postpartum, although the dense lactating breast limits its utility. Lobulated masses with internal branching lucent areas on mammography, with the lucent areas representing the fat content of the milk have been described (Fig. 17). When characteristic imaging features are present in an appropriate clinical context, lactating adenomas are typically assessed as BI-RADS 3, with short-interval imaging follow-up. Lesions demonstrating atypical features, rapid growth, pain, or interval change are categorised as BI-RADS 4 and warrant tissue sampling to exclude malignancy. Histologically, lactating adenomas are composed of tightly packed hyperplastic lobules with actively secreting epithelial and myoepithelial cells, lacking cytological atypia. Infarction within these lesions can cause sudden enlargement and pain, potentially mimicking abscesses or malignancy and complicating the diagnosis. Differential diagnoses include benign entities such as galactoceles,

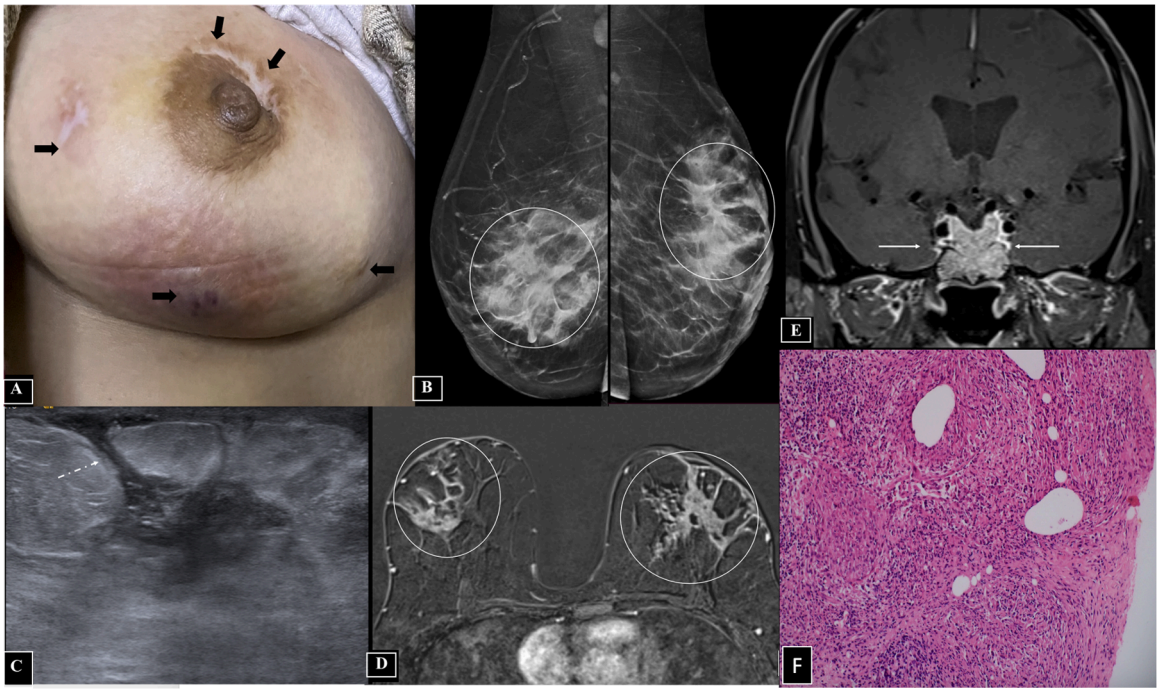

Fig. 16. Granulomatous mastitis in a 44-year-old woman. Clinical photograph of the right breast (A) demonstrating multiple ulcerations with discharging sinuses (black solid arrows). Mammography in mediolateral oblique (MLO) view (B) shows focal asymmetries with architectural distortion in both breasts (white circles). Targeted ultrasound (C) revealed a collection and a hypoechoic tubular structure with finger-like extensions infiltrating into the breast parenchyma, with a tract extending to the skin surface (white dashed arrow). Postcontrast axial MR image (D) demonstrating bilateral, multiple, rim-enhancing, confluent masses, each <1 cm in diameter, suggestive of microabscess formation (white circles). The abnormality was classified as BI-RADS 4, and subsequent US-guided core-needle biopsy confirmed acute-on-chronic granulomatous mastitis. As bilateral granulomatous mastitis is uncommon and the patient was not in the postpartum period, an MRI of the brain was performed to assess the cause of hyperprolactinemia. (E) Coronal post-contrast T1-fat saturated images showing pituitary macroadenoma with sellar expansion (white thin arrows), depicting the cause of hyperprolactinemia. (F) Histopathological examination from the breast showing numerous granulomas centred around the terminal duct–lobular unit with associated destruction (H&E, × 200).

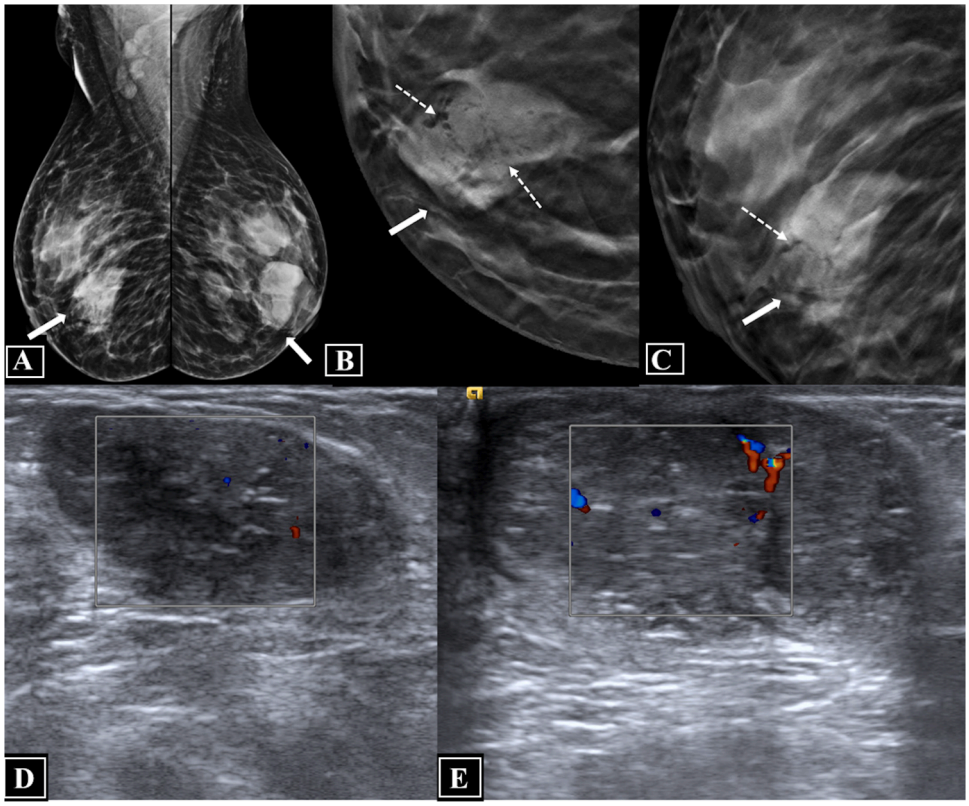

Fig. 17. Lactating adenoma in a postpartum female who had a past history of bilateral breast lumps and recent awareness of an increase in the size of the lump in the right lower breast. Mammography of bilateral breasts in mediolateral oblique (MLO) view (A), along with zoomed-in tomosynthesis images of the right breast in craniocaudal (CC) (B) and mediolateral oblique (C) views demonstrating well-circumscribed masses in the bilateral breasts (white solid arrow), with the mass in right lower breast depicting internal branching lucent areas representing the fat content of milk (white dashed arrows). Targeted ultrasound revealed a heteroechoic, circumscribed right breast mass with posterior acoustic enhancement and some internal vascularity. Biopsy of this mass revealed fibroadenoma with lactational changes.

abscesses, and fibroadenomas, as well as malignant lesions like phyllodes tumors, pregnancy-associated breast cancer, and sarcoma. Although generally self-limiting, persistent or symptomatic adenomas may require treatment with bromocriptine or rarely surgical excision. While lactating adenomas do not have inherent malignant potential, rare cases of coexistent breast cancer have been reported, reinforcing the need for histopathological confirmation of atypical presentations. In appropriately selected patients, characteristic imaging and clinical

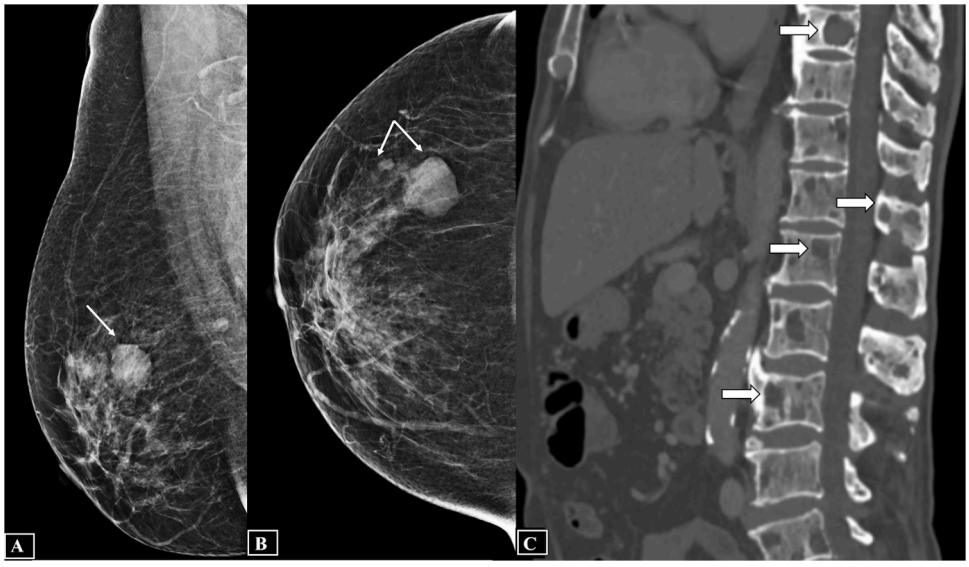

Fig. 18. Multiple myeloma in a 73-year-old female who was on treatment and presented with recent awareness of a lump in the right breast. Mammography in mediolateral oblique (A) and cranio-caudal (B) views reveals two circumscribed equal-density masses in the upper outer quadrant (thin white arrows). Low-dose whole-body CT image obtained via sagittal reconstruction (C) shows multiple lytic intramedullary lesions involving the anterior and posterior elements (solid white arrows).

features may allow conservative management with close follow-up rather than immediate intervention.

Stromal disease

Multiple myeloma/plasmacytoma

Plasma cell dyscrasias arise from monoclonal proliferation of plasma cells and may manifest as solitary plasmacytomas or part of systemic multiple myeloma. Breast involvement by plasma cell dyscrasias is rare, usually in the context of disseminated multiple myeloma, although solitary extramedullary plasmacytoma may occur. Patients present with unilateral or bilateral palpable masses. On mammography, lesions typically appear as round or oval, circumscribed, high density masses, without calcifications (Fig. 18). Lesions may be unilateral or bilateral and can be solitary or multiple. Ultrasound reveals oval or round hypoechoic masses with either circumscribed or indistinct margins and, at times, an echogenic rim.[35] On MRI, plasmacytomas are iso- to hypointense on T1 and hyperintense on T2, with homogeneous post-contrast enhancement. Given the nonspecific but solid nature of these lesions and the inability to reliably distinguish them from primary breast malignancy or lymphoma on imaging alone, breast plasmacytomas are generally categorized as BI-RADS 4, and tissue diagnosis is required. Histopathology shows dense sheets of mature and atypical plasma cells with eccentric nuclei and perinuclear clearing, confirming monoclonal proliferation. Management depends upon the extent.

Metastases

Secondary involvement of the breast by non-mammary malignancies is uncommon, accounting for 0.2–1.3% of all breast malignancies.[36] Reported primaries include melanoma, lung, ovarian, gastric, renal, pancreatic, esophageal, thyroid, sarcoma, and lymphoma; in children, rhabdomyosarcoma and neuroblastoma are typical. Metastatic disease may present as the first manifestation of an occult malignancy. Mammographic findings are variable, ranging from solitary or multiple circumscribed high-density masses. Calcifications can be observed with metastases from papillary thyroid carcinoma, serous ovarian carcinoma, chondrosarcoma/osteosarcoma and mucinous adenocarcinomas (Fig. 19). Ultrasound typically reveals hypoechoic, circumscribed masses with posterior acoustic enhancement. Clues favoring metastases include bilateral distribution, absence of spiculations, absence of associated desmoplastic reactions, and rapid interval progression. Suspected breast metastases are generally assigned a BI-RADS 4 category. Core needle biopsy with immunohistochemistry is mandatory, with ER/PR/HER2 negativity and the use of tumor-specific markers aiding in diagnosis. In cases of suspected lymphoma, the tissue should be preserved in saline for optimal analysis. Histologically, features such as periductal and perilobular infiltration, the absence of intraductal components, and lymphatic emboli support the diagnosis of secondary, non-mammary metastases. Recognition is crucial since management focuses on systemic therapy directed at the primary cancer rather than local breast-directed therapy, although lumpectomy may be considered when the disease burden is minimal.

Cowden syndrome

Cowden syndrome (CS), or multiple hamartoma syndrome, is an uncommon autosomal dominant hereditary condition caused by germline mutations in the PTEN tumor suppressor gene in the long arm of chromosome 10 (10q23). Multiple hamartomatous lesions are observed in the mucosa, skin, and thyroid glands, such as mucocutaneous lesions in the gastrointestinal and genitourinary tracts with central nervous system lesions (cerebellar gangliocytoma).[37] In breast, multiple hamartomas can be observed in the background of fibroadenomas and fibrocystic disease. Mammography and ultrasound reveal multiple

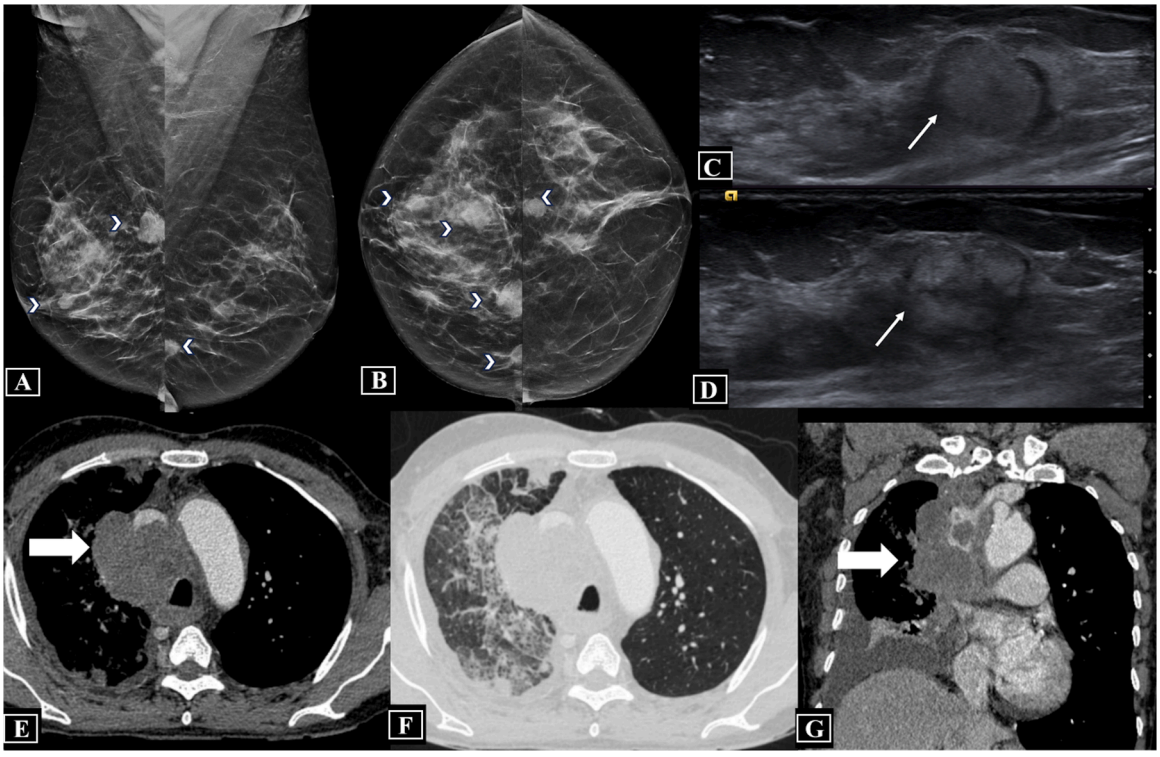

Fig. 19. Intramammary metastases from lung carcinoma in a 62-year-old woman. Mammography in mediolateral oblique (MLO) (A) and craniocaudal (CC) (B) views demonstrates multiple irregular masses in the bilateral breasts (white arrowheads). Targeted ultrasound (C, D) reveals corresponding heteroechoic masses. Contrast-enhanced CT in the axial soft tissue window (E), lung window (F), and coronal soft tissue reconstruction (G) shows a right hilar mass with mediastinal lymphadenopathy, associated interlobular septal thickening, and a mass effect on the adjacent vasculature (thick white arrows).

circumscribed masses (Fig. 20). There is an increased risk of ductal carcinoma in situ, invasive ductal carcinoma (lifetime risk >60%), endometrial, follicular or papillary cancer, and macrocephaly in CS. Hence, the radiologist's role lies in early recognition and initiation of surveillance protocols. Individual circumscribed masses without suspicious imaging features are commonly assessed as BI-RADS 2 or 3. Any lesion demonstrating interval growth, irregular margins, or suspicious calcifications should be categorised as BI-RADS 4 and biopsied to exclude malignancy. Annual screening mammography and MRI are recommended for these patients beginning at 30 years of age or 5–10 years before the earliest known age of breast cancer in the family, whichever comes first.[38] The other syndromes associated with PTEN mutation are Lhermitte-Duclos disease and Bannayan-Riley-Ruvalcaba syndrome (BRRS).

Amyloidosis

Amyloidosis is a disorder characterized by the accumulation of insoluble protein deposits in extracellular tissues, most commonly immunoglobulin light chains (AL type) or serum amyloid A protein (AA type). It often affects organs such as the heart, kidneys, lungs, gastrointestinal tract, skin, and peripheral nerves. While breast involvement is rare, it may be either localized or more commonly part of systemic amyloidosis, usually appearing later in the course of the disease.[39] Clinically, it is seen in older women (60–70 years), and patients may present with a palpable, nontender breast mass. On imaging, mammography may reveal an irregular or spiculated mass, focal asymmetry, or clustered microcalcifications. Ultrasound may reveal ill-defined hypo- or isoechoic avascular masses (Fig. 21). Posterior acoustic shadowing may be present. The main differentials include breast carcinoma, fat necrosis and sclerosing adenosis. Given the frequent malignant-appearing imaging features and lack of reliable benign characteristics, breast lesions related to amyloidosis are generally categorized as BI-RADS 4. Histologic confirmation is typically achieved through core or excisional biopsy, with Congo red staining and polarized light microscopy or immunohistochemistry used for definitive diagnosis. Although breast amyloidosis may coexist with primary breast cancer, the exact relationship remains unclear.[40] Localized breast amyloidosis is exceedingly uncommon, accounting for just 0.5% of cases in specialized amyloidosis centers. Treatment is based on the underlying form: localized disease is managed with surgical excision, whereas systemic amyloidosis requires treatment of the primary systemic condition.

Chronic cardiac and kidney disease

Breast edema can occur in both malignant and nonmalignant conditions. Inflammatory breast carcinoma presents with diffuse breast edema due to lymphatic obstruction, but several benign and systemic disorders may mimic this appearance. On mammography, the characteristic features include diffuse breast enlargement, increased parenchymal density, skin thickening, and trabecular coarsening. Bilateral breast edema is most often related to systemic causes, such as congestive

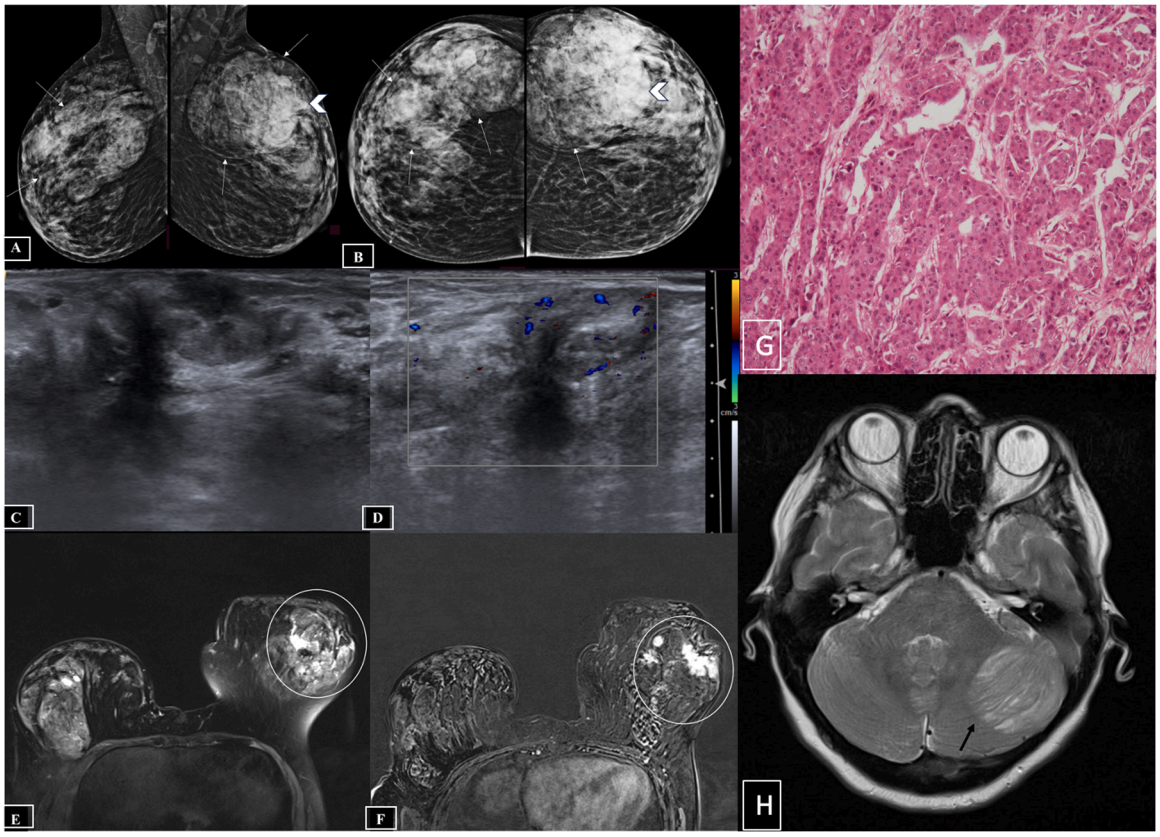

Fig. 20. Invasive ductal carcinoma (IDC) arising in a hamartoma in a 48-year-old woman with Cowden syndrome: Mammography in mediolateral oblique (MLO) (A) and craniocaudal (CC) views (B) shows multiple hamartomas in bilateral breasts (thin white arrows), with one hamartoma in the left breast demonstrating high density within (white arrowhead). Targeted ultrasound (C, D) revealed an irregular heteroechoic mass that was not parallel in orientation, had angular margins and showed mildly increased vascularity within the left breast hamartoma. T2-Spectral attenuated inversion recovery image (SPAIR) (E) and dynamic postcontrast subtracted images (F) in an axial section show a T2 heterogeneous, irregular mass depicting early enhancement within the left hamartoma (white circle). Ultrasound guided core biopsy revealed IDC within the hamartoma. (G) Histopathology suggestive of invasive breast carcinoma, no special type (NST), showing an invasive tumour composed of cords, trabeculae, and nests of tumour cells exhibiting moderate nuclear pleomorphism (H&E, × 200). (H) T2 axial MR image of the brain, shows thickening and hyperintensity in the left cerebellar folia consistent with coexistent dysplastic cerebellar gangliocytoma (black thin arrow).

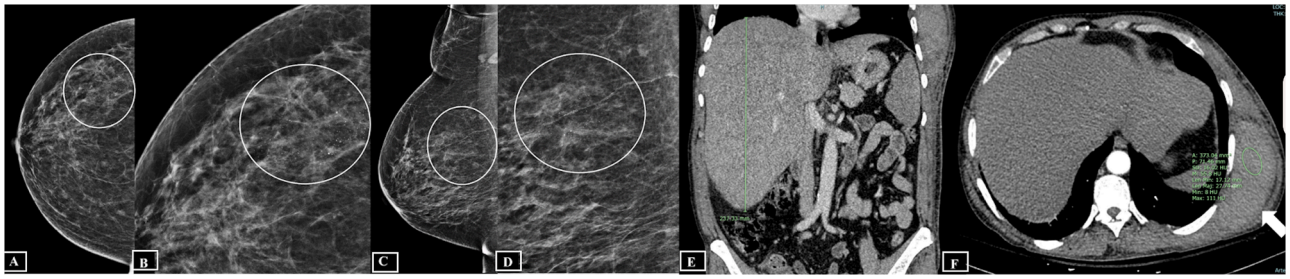

Fig. 21. Amyloidosis in a 56-year-old woman. Mammography of the craniocaudal (CC) (A), magnified CC (B), mediolateral oblique (MLO) (C), and magnified views (D) demonstrating grouped microcalcifications in the upper outer quadrant of the right breast (white circle). Given the suspicion of malignancy, a biopsy was performed, confirming amyloidosis. The coronal contrast-enhanced computed tomography (CECT) of the abdomen of the patient revealed massive hepatomegaly (E), and the axial non-contrast CT image revealed spontaneous hematoma in the left chest wall (thick white arrow) (F).

heart failure, nephrotic syndrome, chronic kidney disease, or hepatic failure, where the underlying mechanism is fluid overload and hypoalbuminemia. In chronic kidney disease, dermal or vascular calcifications may coexist; in such cases, a tangential magnification view or tomosynthesis can help localize dermal deposits. In contrast, unilateral breast edema is more suggestive of localized pathology. Common causes include infectious mastitis, abscess, postsurgical or post-radiation changes, venous or lymphatic obstruction, and malignant axillary lymphadenopathy leading to impaired drainage. Axillary or subclavian vein thrombosis rarely presents with acute unilateral breast edema. Thus, while diffuse breast edema is suspicious of inflammatory carcinoma, clinical history, bilaterality, associated systemic findings, and targeted imaging evaluation are essential to distinguish between malignant and benign etiologies (Fig. 22).[41,42] Diffuse bilateral edema in the setting of systemic disease is usually assessed as BI-RADS 2, whereas unilateral edema with suspicious associated findings warrants BI-RADS 4 assessment and further diagnostic evaluation.

Infectious diseases

Tuberculosis

Tuberculosis (TB) of the breast may present in a wide variety of patterns. The breast may be affected primarily or, more frequently, secondarily from contiguous spread via the chest wall, pleura, or axillary lymph nodes. In terms of pathology, several forms have been described, including nodular mastitis, mastitis obliterans, disseminated mastitis, sclerosing mastitis, and, rarely, acute miliary mastitis. On mammography, TB can manifest as high- or equal-density masses, architectural distortion (especially in disseminated forms), or diffuse asymmetry.

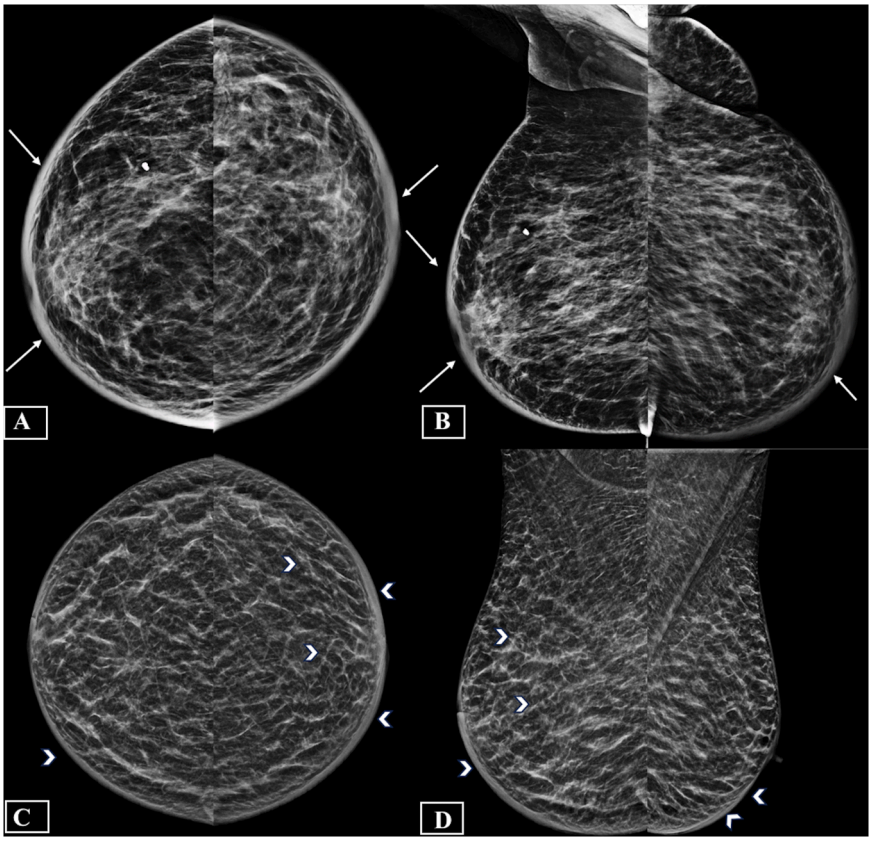

Fig. 22. Mammography of the craniocaudal (CC) (A) and mediolateral oblique (MLO) views (B) of both breasts showing diffuse skin thickening with breast edema in a patient with congestive heart failure. Mammography of the craniocaudal (CC) (thin white arrows) (C) and mediolateral oblique (MLO) views (D) of both breasts revealed diffuse skin thickening with breast edema in another patient with bilateral chronic renal disease (white arrowheads).

Associated axillary lymphadenopathy is common; the presence of coarse, dense calcifications within axillary lymph nodes are highly suggestive of tuberculosis, particularly in high-prevalence regions (Fig. 23). Fistula formation is characterized by skin thickening and irregularity. Disseminated mastitis affects larger areas of the breast, depicting multiple collections in the breast with sinus tracts, fistulas, and skin thickening. Sclerosing mastitis leads to intense fibrosis, nipple retraction and skin thickening. Given the frequent overlap with breast carcinoma and inflammatory breast cancer, imaging findings of sclerosing type of breast tuberculosis maybe commonly categorised as BI-RADS 4. The final diagnosis is based on tissue biopsy or aspiration and culture.[43, 44, 45]

Breast abscess

Breast abscesses may be lactational or non-lactational, with the former usually arising in the puerperal period due to *Staphylococcus aureus* infection, whereas the latter are common in periareolar or subareolar locations and are associated with risk factors such as smoking, diabetes, and immunosuppression, including HIV infection, steroid therapy, or posttransplant status (Fig. 24). Non-lactational abscesses are often polymicrobial with a significant anaerobic component, and many are related to periductal mastitis or squamous metaplasia of the lactiferous ducts, which predisposes the patients to recurrence unless the diseased duct is excised. Imaging plays a central role in diagnosis and management. Mammography is generally reserved for nonlactating women or atypical presentations, showing nonspecific features such as focal asymmetry, architectural distortion, and trabecular thickening, and is particularly useful for excluding an underlying neoplasm in patients over 30 years of age or in those with delayed resolution. Ultrasound is the modality of choice, typically demonstrating a hypoechoic or complex multiloculated collection with internal debris, a thick, irregular wall, peripheral hyperemia on Doppler, and associated skin thickening or fistulous tracts. In the appropriate clinical context, imaging features consistent with abscess are generally categorized as BI-RADS 2. However, lesions with atypical imaging features, poor response to therapy, or associated suspicious findings should be assigned BI-RADS 4 and biopsied to exclude malignancy. Management involves empiric antibiotics adjusted according to culture, with ultrasound-guided aspiration being the preferred first-line intervention, repeated as necessary until resolution, while catheter drainage or surgical incision and drainage are reserved for large, multiloculated, or recurrent abscesses. Differential diagnoses include idiopathic granulomatous mastitis, tuberculous mastitis, and inflammatory breast carcinoma, the latter of which must be considered in cases of unilateral breast edema or when symptoms persist despite appropriate therapy, warranting biopsy to establish a definitive diagnosis.[46]

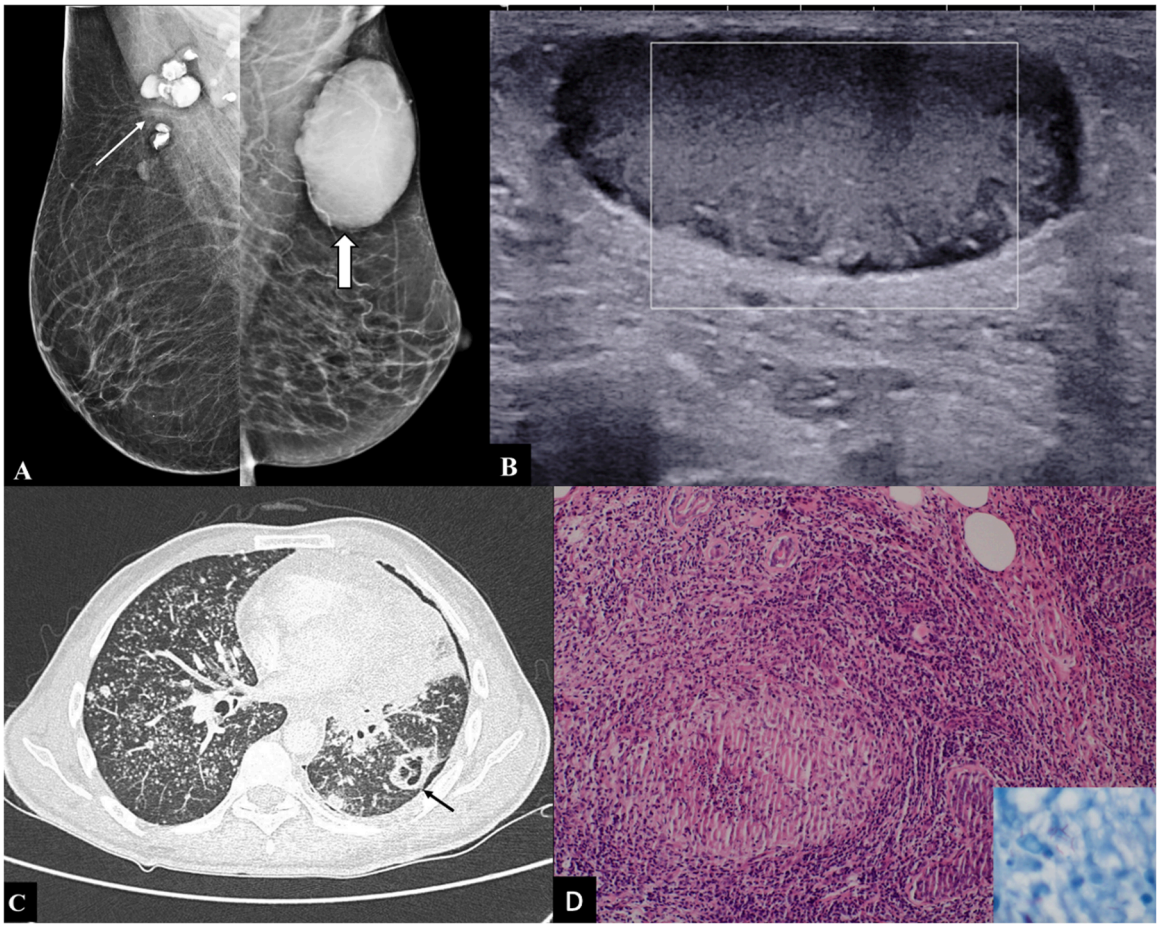

Fig. 23. A 42-year-old woman with tubercular mastitis. Mammography in mediolateral oblique (MLO) view (A) shows an oval, circumscribed mass in the left axilla and upper breast (thick white arrow), along with calcified lymph nodes in the right axilla (B, thin white arrow). Targeted ultrasound of the left breast revealed an organized collection, the aspirate from which yielded thick pus with GeneXpert positivity for Mycobacterium tuberculosis. Axial high-resolution computed tomography (HRCT) of the chest (C) revealed cavitation in the left lower lobe (black arrow), with multiple bilateral miliary and centrilobular nodules displaying a tree-in-bud configuration, which was consistent with tuberculosis. (D) Histopathology revealing necrotising granulomas within the lobule (H&E, × 200). Inset: Acid fast bacilli (AFB) positivity confirming mycobacterial aetiology.

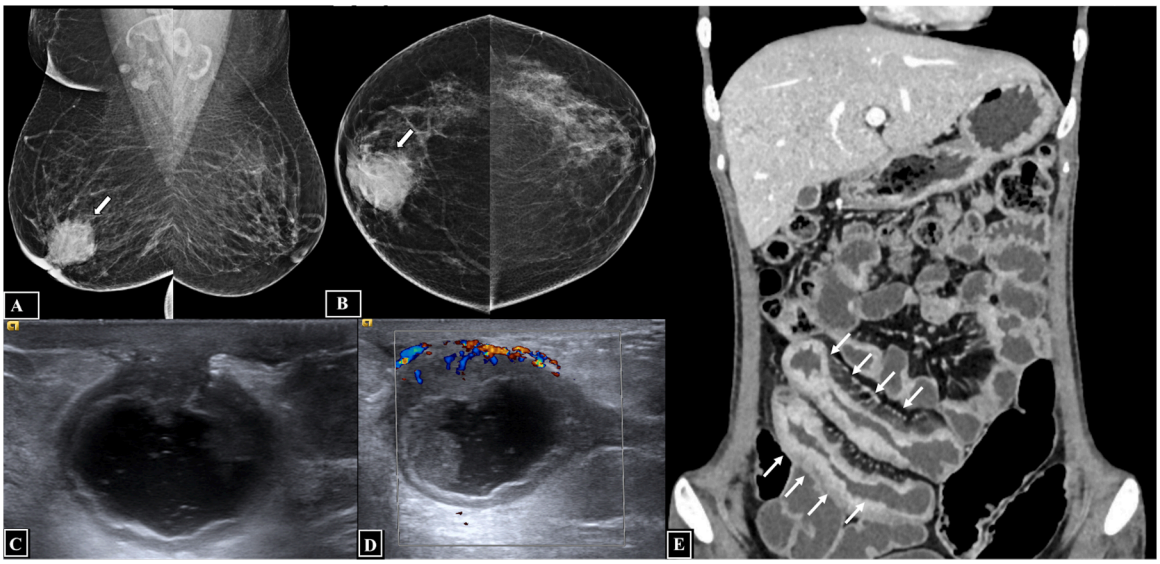

Fig. 24. Crohn's disease in an immunosuppressed 41-year-old woman on long-term oral corticosteroid therapy. Mammography in the mediolateral oblique (MLO) (A) and craniocaudal (CC) (B) views demonstrate a high-density, irregular mass in the retroareolar location of the right breast (solid white arrow). Targeted ultrasonography (C, D) revealed a thick walled, heteroechoic mass with internal echoes and debris along with prominent peripheral vascularity, suggesting a breast abscess. Coronal CT enterography (E) revealed a long segment of asymmetric circumferential mural thickening in the small bowel loops with mesenteric fat stranding and engorged vasa recta, producing the characteristic "comb sign" (thin white arrows).

Filariasis

Breast filariasis is the most common parasitic infection of the breast, seen often in the upper outer quadrant, caused by *Wuchereria bancrofti.* The lymphatic form results in lymphangitis, fibrosis, and lymphatic stasis, leading to acute inflammation, lump awareness, dermal hyperemia, edema, and peau d'orange. Histopathology shows dilated lymphatics containing adult filarial worms or microfilariae with prominent eosinophilic infiltration, granulomatous response, and surrounding fibrosis. Mammography reveals circumscribed equal- or high-density masses, which, on ultrasound correlation, show hyperechoic linear intracystic/intralymphatic parasites exhibiting rapid nonrhythmic movements, termed classical "filarial dance" (Fig. 25). The swirling of the parasite results in a "color motion artifact" on Doppler US. In chronic infections, dead parasites may present linear or serpiginous nonductal calcifications.[47,48] When characteristic imaging features such as the filarial dance sign or non-ductal serpiginous calcifications are present, breast filariasis is appropriately categorized as BI-RADS 2. The mainstay treatment is medical, with a first-line agent as diethycarbamazine (DEC), combined with albendazole or ivermectin in endemic regions.

Cysticercosis

Cysticercosis is an uncommon parasitic infection caused by *Cysticercus cellulosae,* the larval form of *Taenia solium,* which has an endemic distribution in countries such as India, resulting from contamination of food or water. The manifestation is multisystemic, predominantly involving the gray–white matter junction of the brain. [49,50] Occasionally, patients might present with painless nodules, awareness of lump, and pain. Mammary cysticercosis is extremely rare, and when it occurs, it is usually associated with the stigma of cysticercosis in other parts of the body in the form of neurocysticercosis (Fig. 26) or myocysticercosis. On mammography, well-circumscribed, equal-density masses can be seen. In chronic or involuted stages, calcifications may be present, corresponding to calcified cysticerci. These calcifications are usually round or oval and do not follow a ductal distribution. Ultrasound may reveal a

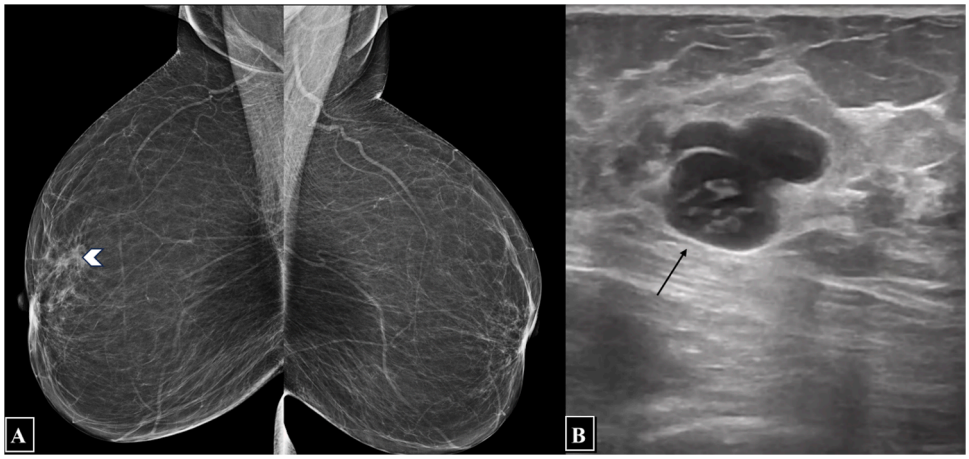

Fig. 25. Filariasis in a 43-year-old woman with right mastalgia. Mammography in the mediolateral oblique view (A) showed elongated and serpiginous densities with focal asymmetry in the upper breast (white arrowhead). Targeted ultrasound (B) revealed a dilated lymphatic channel with echogenic structures within it (black arrow), which, via real-time visualization, depicted nonrhythmic, rapid twirling movement, representing "filarial dance" (Supplemental video).

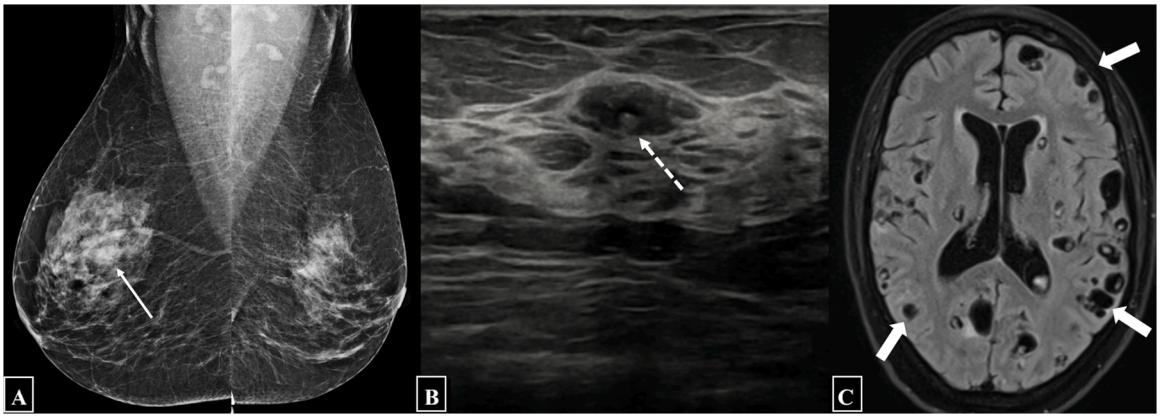

Fig. 26. Cysticercosis in a 38-year-old female. Mammography in the mediolateral oblique (MLO) view (A) demonstrates an equal density mass in the central breast (white arrow). Targeted ultrasonography (B) reveals an anechoic cyst with an echogenic eccentric scolex (dotted white arrow). Axial T2 fluid-attenuated inversion recovery (FLAIR) (C) MRI image of the patient's brain showing multiple cysts present at the gray-white matter junction, depicting an eccentric scolex (thick white arrows).

complicated cyst with an eccentric echogenic focus, indicating the scolex. The sonographic differentials include papilloma and carcinoma, which can be differentiated with the help of color Doppler. FNAC is usually diagnostic, demonstrating hooklets and scolices, with management requiring systemic therapy.

Conclusion

Numerous breast abnormalities that can be detected via mammography due to systemic disorders can have vascular, lymphatic, cutaneous, or parenchymal origins. These manifestations can arise from virtually any organ system, and their recognition demands a high index of suspicion and familiarity with characteristic imaging patterns (Fig. 27). For breast radiologists, accurately distinguishing systemic disease from primary breast malignancy is critical to avoid unnecessary interventions, guide appropriate management, and, in some cases, reveal an undiagnosed systemic condition. Knowledge of these manifestations can also provide information about a patient's overall health. A precise diagnosis and suitable surveillance are crucial since certain systemic illnesses, such as Cowden syndrome, not only affect the breast but also increase the risk of breast cancer. The clinical, radiological, and pathological characteristics of several systemic disorders involving the

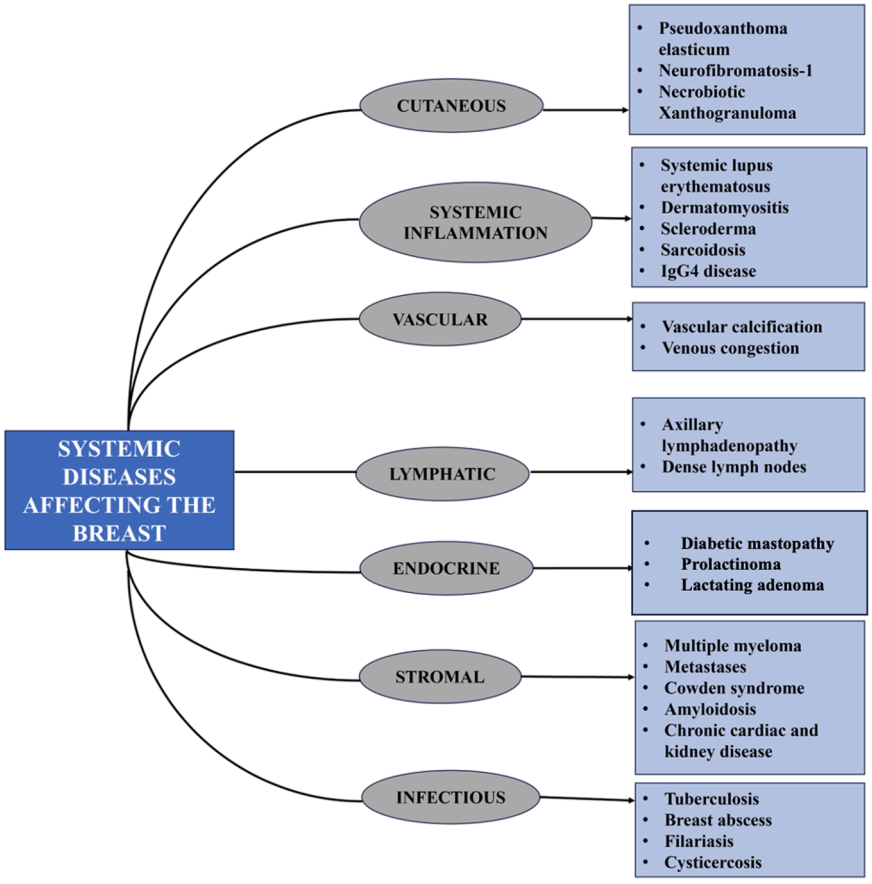

Fig. 27. Flowchart summarizing the various systemic diseases affecting the breast.

breast, as well as therapy concerns, are highlighted in this study. Although uncommon, these entities carry significant diagnostic and therapeutic implications. Mastery of their clinical, radiologic, and pathologic features enables timely diagnosis, optimized treatment, and truly patient-centered care—while never overlooking breast cancer as a key differential.

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Declaration of competing interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1067/j.cpradiol.2026.01.003.

References

1. Harmsen IM, Kok M, Visseren FL, et al. High prevalence of breast arterial calcification in pseudoxanthoma elasticum (PXE)–A nationwide study in the Netherlands. *Vasc Med*. 2024;29:716–717. https://doi.org/10.1177/1358863x241268872.
2. Kranenburg G, de Jong PA, Mali WP, et al. Prevalence and severity of arterial calcifications in pseudoxanthoma elasticum (PXE) compared to hospital controls. Novel insights into the vascular phenotype of PXE. *Atherosclerosis*. 2017;256:7–14. https://doi.org/10.1016/j.atherosclerosis.2016.11.012.
3. Watik F, Harrad M, Sami Z, et al. Breast neurofibroma: A case report. *Int J Surg Case Rep*. 2022;98, 107533. https://doi.org/10.1016/j.ijscr.2022.107533.
4. Yin C, Porembka JH, Hwang H, et al. Neurofibroma in the breast: diagnosis and management considerations. *J Breast Imaging*. 2021;3:363–368. https://doi.org/10.1093/jbi/wbab008.
5. Kouli A, Alayoubi A, Alali M, et al. Breast carcinoma in a patient with neurofibromatosis type 1 and huge plexiform neurofibroma of the contralateral breast: a case report. *BMC Women's Health*. 2025;25:360. https://doi.org/10.1186/s12905-025-03908-8.
6. Zahid IG, Kummarapurugu S, Alrefai S. Xanthogranulomatous breast mass: an unusual presentation. *Cureus*. 2021;13, e17973. https://doi.org/10.7759/cureus.17973.
7. Maxwell AJ, Axcell K, Helm TN, et al. Progressive painful plaque on the right breast: answer. *Am J Dermatopathol*. 2025;47:327–328. https://doi.org/10.1097/dad.0000000000002928.
8. Voizard B, Lalonde L, Sanchez LM, et al. Lupus mastitis as a first manifestation of systemic disease: about two cases with a review of the literature. *Eur J Radiol*. 2017;92:124–131. https://doi.org/10.1016/j.ejrad.2017.04.023.
9. Oktay A, Esmat HA, Aslan Ö, et al. Lupus mastitis in a young female mimicking a breast carcinoma; a rare entity through a case report and review of the literature. *Eur J Breast Health*. 2021;18:13. https://doi.org/10.4274/ejbh.galenos.2021.6361.
10. Requena C, Alfaro A, Traves V, et al. Paraneoplastic dermatomyositis: a study of 12 cases. *Actas Dermo-Sifiliog. (English Edition)*. 2014;105:675–682. https://doi.org/10.1016/j.ad.2013.11.007.
11. Singla V, Prabhakar N, Singh T, et al. Mammography findings of breast calcinosis in a patient with dermatomyositis. *JCR: J Clin Rheumatol*. 2017;23:341. https://doi.org/10.1097/rhu.0000000000000546.
12. Orton C, Topham C, Madigan LM. Paraneoplastic dermatomyositis. *Am J Med*. 2022;135:969–971. https://doi.org/10.1016/j.amjmed.2022.01.016.
13. Tang EY, Varughese S, Herrick AL. Systemic sclerosis-related calcinosis can affect the breast–but malignancy should always be excluded. *Scand J Rheumatol*. 2021;50:78–79. https://doi.org/10.1080/03009742.2020.1727564.
14. Avanoglu-Guler A, Campochiaro C, De Luca G, et al. Calcinosis in systemic sclerosis: An update on pathogenesis, related complications, and management: A heavy burden still waiting to be lifted off patients' hands. *Semin arthritis rheum*. 2024;66, 152431. https://doi.org/10.1016/j.semarthrit.2024.152431.
15. Kaddoura R, Al Haj M, Faraji H, et al. A rare case of sarcoidosis presenting as an isolated breast mass and pain: a case report and literature review. *Am J Case Rep*. 2023;24, e940919. https://doi.org/10.12659/ajcr.940919.
16. Erivwo P, Turashvili G. Pathology of IgG4-related sclerosing mastitis. *J Clin Pathol*. 2021;74:475–482. https://doi.org/10.1136/jclinpath-2020-207029.
17. Singla V, Garg D, Chatterjee D, Lal R, Basher RK, Khare S. Perplexing case of IgG4-related mastitis: hitherto undescribed contrast-enhanced mammography features. *Indian J Radiol Imaging*. 2025. https://doi.org/10.1055/s-0045-1811211.
18. Allen TS, Bui QM, Petersen GM, et al. Automated breast arterial calcification score is associated with cardiovascular outcomes and mortality. *JACC: Adv*. 2024;3, 101283. https://doi.org/10.1016/j.jacadv.2024.101283.
19. Rossi J, Cho L, Newell MS, et al. Breast Arterial Calcifications on Mammography: A Review of the Literature. *J breast imaging*. 2025;7:268–279. https://doi.org/10.1093/jbi/wbaf009.
20. Saccenti L, Jedida BB, Minssen L, et al. Evaluation of a deep learning-based software to automatically detect and quantify breast arterial calcifications on digital mammogram. *Diagn Interv Imaging*. 2025;106:98–104. https://doi.org/10.1016/j.diii.2024.10.001.
21. Khera SY. Superior vena cava syndrome as unilateral right breast enlargement. *J Vasc Surg Cases Innov Tech*. 2022;8:477–479. https://doi.org/10.1016/j.jvscit.2022.04.018.
22. Marie L, Julie M, Jérôme M. Recognizing Mondor's Disease: A rare cause of benign breast induration. *Eur J Obstet Gynecol Reprod Biol*. 2025;312, 114530. https://doi.org/10.1016/j.ejogrb.2025.114530.
23. Georgescu R, Podeanu MD, Colcer I, et al. Wegener's granulomatosis of the breast with peculiar radiological aspect mimicking breast carcinoma. *Breast J*. 2015;21:550–552. https://doi.org/10.1111/tbj.12458.
24. Limninart N, Harvey JA, Schultz KJ, et al. What do you mean it's not cancer?" A review of autoimmune and systemic inflammatory diseases involving the breast. *J Breast Imaging*. 2021;3:612–625. https://doi.org/10.1093/jbi/wbab029.
25. Wadhwa A, Majidi SS, Reimer S, et al. Axillary node evaluation and biopsy: Predictors of malignancy based on sonographic morphology and mode of detection. *Clin Imaging*. 2023;104, e110014. https://doi.org/10.1016/j.clinimag.2023.110014.
26. Prativadi R, Dahiya N, Kamaya A, et al. Ultrasound characteristics of benign vs malignant cervical lymph nodes. *In Semin Ultrasound CT MRI*. 2017;38:506–515. https://doi.org/10.1053/j.sult.2017.05.005.
27. Lane EG, Eisen CS, Ginter PS, et al. Ink on the move: tattoo pigment resembling axillary lymph node calcifications. *Clin Imaging*. 2021;79:154–157. https://doi.org/10.1016/j.clinimag.2021.04.036.
28. Guzik P, Gęca T, Topolewski P, et al. Diabetic mastopathy. Review of diagnostic methods and therapeutic options. *Int J Environ Res Public Health*. 2021;31(19):448. https://doi.org/10.3390/ijerph19010448.
29. Salati SA, AlSulaim L. Diabetic mastopathy: A review of a breast carcinoma mimic. *J Diabetol*. 2024;15:4–11. https://doi.org/10.4103/jod.jod_76_23.
30. Zheng Y, Mo W, Yu Y, et al. Breast carcinoma associated with prolactinoma: A case report. *Cancer Biol Ther*. 2017;18:132–136. https://doi.org/10.1080/15384047.2017.1294284.
31. Boldrini C. Granulomatous mastitis (GM) in a young woman with a previous history of prolactin-secreting PitNET and actual normal prolactinemia. *Radiol Case Rep*. 2023;18:550–555. https://doi.org/10.1016/j.radcr.2022.11.012.
32. Zhang Z, Maimone S. I saw the sign: Go nuts, it is the "acorn cyst" sign. *Clin Imaging*. 2023;100:60–63. https://doi.org/10.1016/j.clinimag.2023.05.002.
33. Alenazi M, Howse S, Imran SA. Drug-Induced Hyperprolactinemia and Granulomatous Mastitis: A Case Report and Literature Review. *Case Rep Infect Dis*. 2025;2025, 9409072. https://doi.org/10.1155/crdi/9409072.
34. Ravikanth R, Kamalasekar K. Imaging of lactating adenoma: differential diagnosis of solid mass lesion in a lactating woman. *J Med Ultrasound*. 2019;27:208–210. https://doi.org/10.4103/jmu.jmu_3_19.
35. Alsaleh B, Alanzi A, Alsaeed M, et al. Bilateral Breast Involvement in Multiple Myeloma: A Report of a Rare Case. *Cureus*. 2024;16, e70906. https://doi.org/10.7759/cureus.70906.
36. Sidlauskas K, Elliott P, Makhija P, et al. Metastasis to and from the breast: a guide to differential diagnosis and ancillary testing. *Diagn Histopathol*. 2025;31:162–173. https://doi.org/10.1016/j.mpdhp.2025.01.001.
37. Sueta A, Takeno M, Goto-Yamaguchi L, et al. A progressive and refractory case of breast cancer with Cowden syndrome. *World J Surg Oncol*. 2022;20:279. https://doi.org/10.1186/s12957-022-02745-5.
38. Byakhova MM, Semenova AB, Galkin VN, et al. Breast cancer as part of Cowden syndrome. *Malig Tumors*. 2022;12:36–44. https://doi.org/10.18027/2224-5057-2022-12-2-36-44.
39. Tsuji W, Takeuchi E, Oka S, et al. Localized primary amyloidosis of the breast: a case report and review of the literature. *BMC Surg*. 2016;16:62. https://doi.org/10.1186/s12893-016-0178-6.
40. De Crem AS, Van de Vijver K, et al. Breast Amyloidosis: A Case Report and Literature Review. *J Belg Soc Radiol*. 2022;106:134. https://doi.org/10.5334/jbsr.2988.
41. Farag MA, Alkandary LA, Alshatti MI, et al. Congestive heart failure as a rare cause of unilateral breast edema: A case report & review of the literature. *Egypt J Radiol Nucl Med*. 2018;49:873–877. https://doi.org/10.1016/j.ejrnm.2018.01.010.
42. Voyvoda N, Voyvoda B, Özer T. Screening mammography findings in women with chronic kidney disease on a renal transplant waiting list. *Clin Breast Cancer*. 2019;19:e433–e439. https://doi.org/10.1016/j.clbc.2019.01.009.
43. Singla DV, Garg DD, Dua DA, et al. Imaging enigma in mastitis: A comprehensive study of multifaceted causes, clinical and radiological presentations. *Curr Probl Diagn Radiol*. 2025;54:214–227. https://doi.org/10.1067/j.cpradiol.2024.08.006.
44. Longman CF, Campion T, Butler B, et al. Imaging features and diagnosis of tuberculosis of the breast. *Clin Radiol*. 2017;72:217–222. https://doi.org/10.1016/j.crad.2016.11.023.
45. Yadav S. A rare case of tuberculous nodular breast abscess in an immunocompetent indian female. *Cureus*. 2023;15, e45977. https://doi.org/10.7759/cureus.45977.
46. Omranipour R, Mastitis Vasigh M. Breast abscess, and granulomatous mastitis. *Dis Breast dur Pregnancy Lact*. 2020:53–61. https://doi.org/10.1007/978-3-030-41596-9_7.

47. Sherwani P, Singhal S, Kumar N, et al. Breast filariasis diagnosed by real time sonographic imaging: a case report. *Iran J Radiol.* 2016;13, e17991. https://doi.org/10.5812/iranjradiol.17991.
48. Gulati M, Singla V, Srinivasan R, et al. A word of caution: a case report on breast filariasis masquerading as carcinoma. *Indian J Surg.* 2024;86:207–210. https://doi.org/10.1007/s12262-023-03798-w.
49. Fung KFK, Dixe de Oliveira Santo I, et al. Disseminated Cysticercosis. *Radiographics*. 2025;45, e240244. https://doi.org/10.1148/rg.240244.
50. Singla V, Murugesan K, Singh AK, et al. Isolated breast cysticercosis. *Breast J*. 2020; 26(6):1257–1258. https://doi.org/10.1111/tbj.13811. Epub 2020 Mar 15. PMID: 32172539.