




A new search pattern for emergency breast exams: the clinical picture

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Abstract

Distinct breast diseases are readily diagnosed by clinical and ultrasound appearance that radiologists and sonographers may encounter in emergency room and urgent care patient presentations. While it may be impractical or impossible for the on-call emergency radiologist to examine a patient with breast complaints, radiologists can and should adopt the practice pattern to routinely seek out the clinical photographs in the patient's medical record while interpreting breast examinations. Imaging should be interpreted in the context of both the history and the physical findings. Sonographers play important roles in the documentation of visual inspection findings, in addition to performing high quality targeted ultrasound where applicable. This pictorial offers resources to emergency radiologists and sonographers that facilitate rapid accurate diagnosis of ten distinct breast diseases.

Keywords Breast · Mastitis · Cancer · Breast emergencies · Ultrasound

Introduction

In 2016, breast complaints accounted for 166,304 Emergency Department (ED) visits in the USA [1]. ED visits for breast complaints are most commonly due to breast pain, breast mass, nipple discharge, infection, and post-procedure complications [2].

Patients presenting with breast complaints undergo a clinical breast exam, which includes visual inspection as one component. There are several breast diagnoses that are near-pathognomonic on visual inspection. While it may be impractical or impossible for the on-call emergency radiologist to examine a patient with breast complaints, one can adopt a new approach to the search pattern for breast imaging studies. Importantly, many electronic medical record (EMR) systems incorporate photographs into patients' charts; radiologists must adopt the practice pattern to routinely seek out these clinical photographs while interpreting breast examinations.

Beyond the clinical breast exam, patients are frequently imaged with ultrasound (US) in the ED. After hours, breast US exams may be frequently performed by non-breast certified sonographers and interpreted by emergency radiologists with somewhat limited experience with breast imaging [3]. This pictorial essay correlates the breast clinical exam visual inspection with clinical photographs and sonographic findings in ten distinct breast diagnoses. The authors intend to equip emergency radiologists and sonographers with resources to facilitate more accurate and confident diagnoses of breast diseases.

Puerperal mastitis and abscess

Puerperal mastitis refers to inflammation of the breast during pregnancy and lactation. Commonly caused by infection with *Staphylococcus aureus* or *Streptococcal* species introduced by the nursing infant's nose or throat, puerperal mastitis occurs most commonly in the early postpartum setting; cracked nipple, skin abrasion, or milk stasis are often noted. The best diagnostic clues are clinical history and location. Clinically on visual inspection, the affected breast is painful, edematous, and erythematous, typically in a "wedge-shaped" configuration (Fig. 1A). Prompt antibiotic therapy with empiric coverage against *Staphylococcus aureus* with medications such as dicloxacillin or cephalexin typically prevents abscess formation. Breastfeeding and pumping

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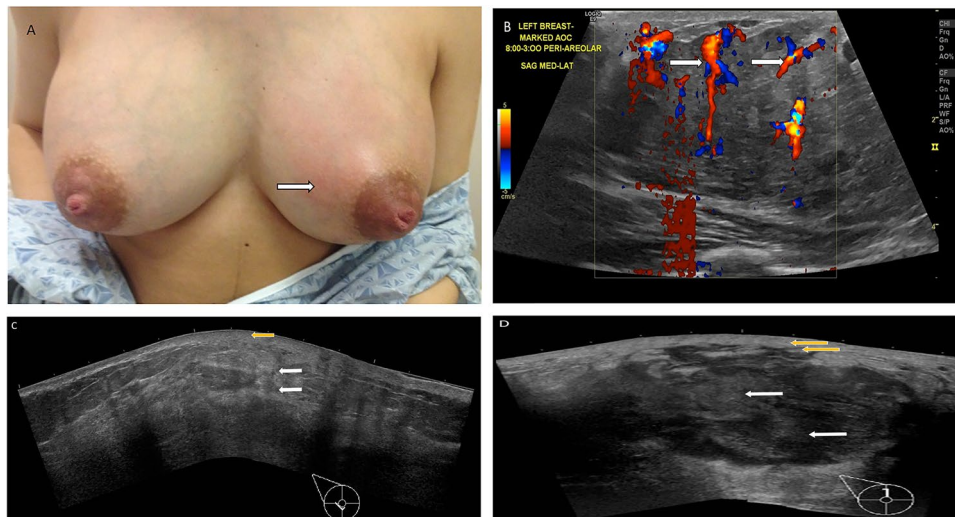


Fig. 1 **A.** A 29-year-old lactating woman presents with left breast erythema in the left upper inner breast (arrow) and tenderness. **B.** Targeted left breast US of the parenchyma displays marked hyperemia (arrows) without abscess. **C.** Companion case 35-year-old lactating woman presents with erythema and breast tenderness. Targeted left breast expanded field of view US displays skin thickening (orange arrow) and parenchyma irregular hypoechoicities without

fluid collection. Findings are consistent with puerperal mastitis without abscess. **D.** Companion case 32-year-old lactating woman presents with fluctuant breast mass, pain and fever. Targeted right breast US displays right breast 7.5 cm collection centered at 12:00 (white arrows) with skin thickening and edema (orange arrows). Aspiration yielded 100 cc purulent fluid, 4+PMNs on gram stain. Findings are consistent with puerperal abscess

should continue as they promote drainage and decompression of the infected breast segment [4].

Ultrasound is typically the imaging modality of choice, if necessary, to evaluate for underlying abscess. US features of mastitis include diffuse or focal skin thickening, edema with hyperechoic fat lobules and dilated interstitial lymphatics, and ill-defined, hypoechoic parenchyma (Figs. 1B and C). Reactive lymph nodes are also commonly present, with diffuse cortical thickening [5]. If present, abscess presents as a complex fluid collection, possibly thick-walled, containing swirling debris, or fluid-debris levels (Fig. 1D). If multiple irregular hypoechoic masses are present, one must also consider granulomatous mastitis, tuberculosis, or multifocal malignancy.

Abscesses may require drainage, often performed percutaneously under ultrasound guidance, for both symptomatic relief as well as to appropriately tailor antimicrobial therapy [6]. Surgical incision and drainage and/or percutaneous drain placement are typically reserved for refractory cases.

Nonpuerperal abscess

Nonpuerperal abscess is an inflammatory lesion not associated with pregnancy. On visual inspection, nonpuerperal abscess presents with a tender and indurated breast lump with overlying erythema (Fig. 2A) [7]. Reactive adenopathy, fever

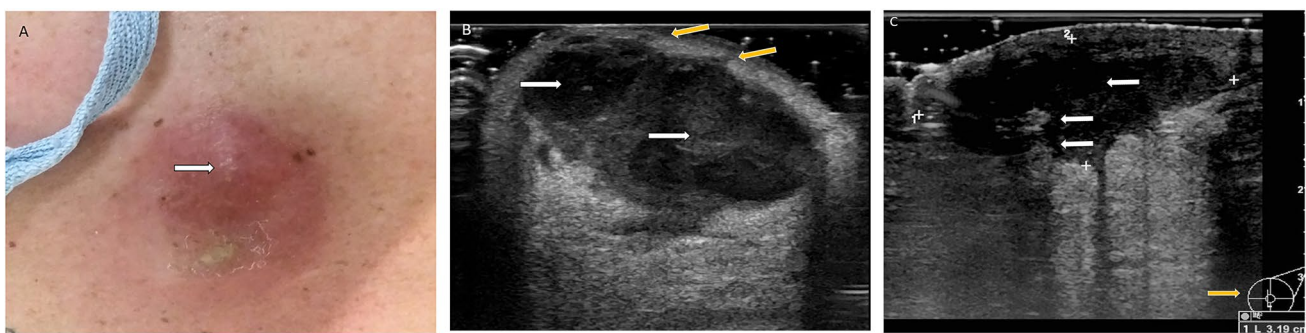


Fig. 2 **A.** A 36-year-old woman presents with a paramidline breast carbuncle (arrow). **B.** US demonstrates a superficial 3.5-cm irregular mass/collection (white arrows) with fistulae to the skin surface (orange arrows), edema, and skin thickening. Aspiration yielded frank pus, while Gram stain of the fluid showed 2+ polymorphonuclear leukocytes, 4+ gram positive cocci, and 1+ gram positive bacilli

with culture mixed anaerobes. **C.** Companion case 23-year-old female smoker presents with subareolar erythema, pain, and mass. USA demonstrates a superficial 3.2-cm complex cystic and solid mass (white arrows) located in the medial subareolar breast (pictograph orange arrow). Findings are compatible with non-puerperal abscesses

and malaise are variably present. US features include complex fluid collection or complex cystic and solid mass(es), often thick-walled and multiloculated (Figs. 2B and C).

Nonpuerperal abscesses are classified as peripheral or central [5]. Central abscesses occurring in the subareolar region are more common and typically present in younger women, smokers (e.g. SMOLD—squamous metaplasia of lactiferous ducts), nipple piercings, or nipple inversion [5, 7]. Peripheral abscesses are less common, often associated with older women with underlying medical conditions, such as obesity, diabetes, HIV, steroids, or smoking [5].

There are several proposed mechanisms of non-puerperal abscess, including lactiferous duct or periareolar follicle obstruction. Subareolar non-puerperal abscesses are most often caused by *Staphylococcus* species, though recurrence is associated with mixed aerobes and anaerobes [7]. Therefore, antibiotic coverage must target a broader spectrum of organisms. Fistulae are present in up to one third of patients (Fig. 2B) [5].

Granulomatous mastitis

Granulomatous mastitis (GM) is an inflammatory, non-malignant pathology of the breast that usually presents as unilateral pain and/or mass. GM typically affects women of childbearing age, often within a few years of delivery, who are of Latina, Asian, and African-American descent. The etiology of GM is unknown, but is thought to be of autoimmune, hormonal, infectious etiology, or some combination of the three [8]. At this time, there are no pathognomonic signs of GM on imaging, although physical exam findings may be characteristic. Evidence of multiple prior episodes including biopsy tracts may be evident (Fig. 3A). On ultrasound, GM presents with multifocal often contiguous irregular hypoechoic masses with variable posterior enhancement and/or shadowing, with associated sinus tracts (Fig. 3B) [8, 9].

Though patient demographics and physical findings may be highly suggestive of GM, it remains a diagnosis of exclusion and histopathologic diagnosis via core needle biopsy is almost always required to confirm the diagnosis of granulomatous mastitis and to exclude malignancy [9].

Breast hematoma

Breast hematoma, a collection of blood under the skin surface, is relatively rare, but can occur due to trauma (ex. seat-belt or airbag trauma), intervention (ex. core needle biopsy or breast surgery), or as sequelae from anticoagulant therapy [10]. Hematoma usually presents as a tender mass, often with ecchymosis on the overlying skin (Fig. 4A). Ultrasound shows a mixed echogenicity mass with hypoechoic and hyperechoic components that increase in echogenicity as

clotting begins (Fig. 4B). The surrounding tissue is hyperechoic due to surrounding edema. Doppler ultrasound is helpful to differentiate avascular hematoma from hypervascular mass. Although CT is not a first-line modality for breast imaging, a breast hematoma may be evident on an emergency trauma chest CT as a hyperdense mass [10].

Skin cyst

Epidermal inclusion cysts (EIC) and sebaceous cysts result from keratin or sebum debris build up within the dermis, which can occur in the breast, as well as face, trunk, neck,

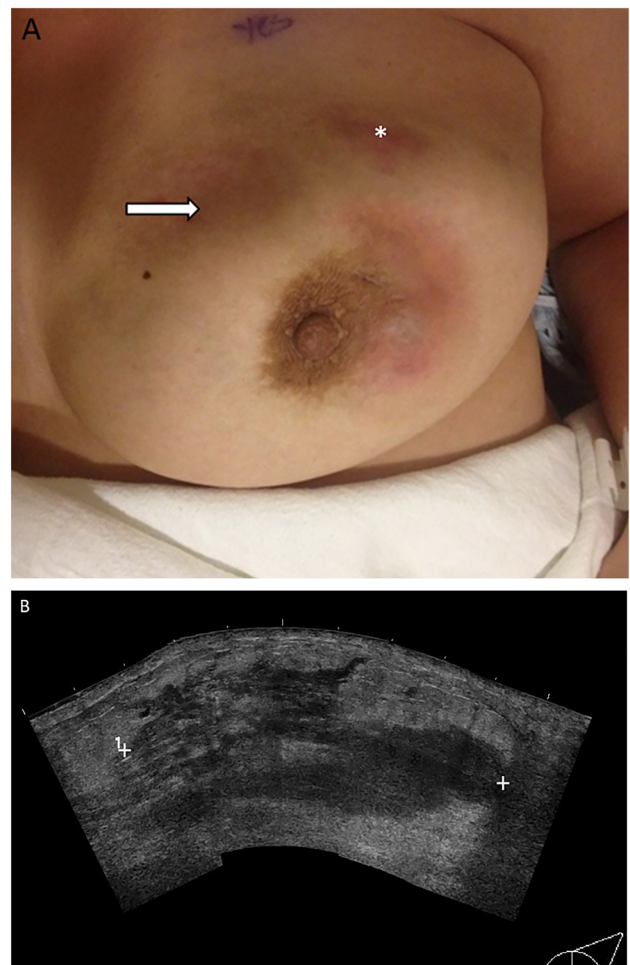
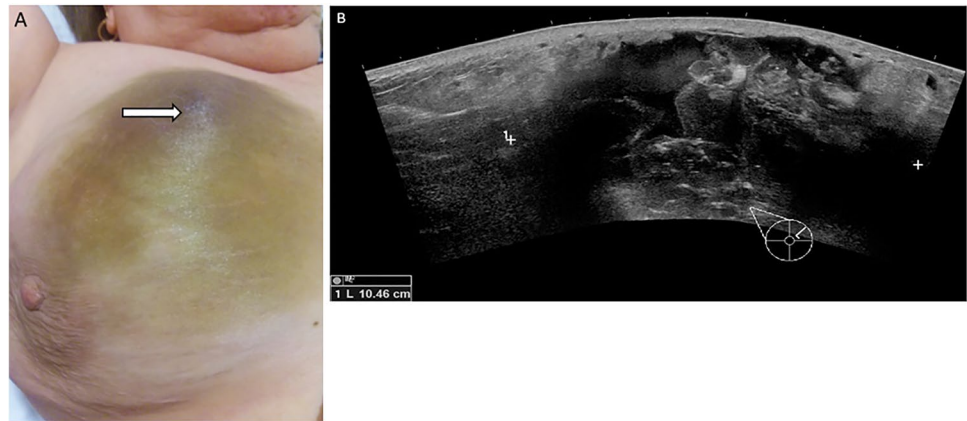


Fig. 3 **A.** A 27-year-old Latina woman presents with left breast acute lateral periareolar inflammation superimposed on chronic left breast inflammatory disease. She has a history of recent core needle biopsy in the upper inner quadrant yielding marked acute and chronic inflammation with a prominent granulomatous component consistent with granulomatous lobular mastitis. At 12:00, there is skin scarring from an earlier GM bout (asterisk), and there is skin bruising in the upper inner quadrant from recent biopsy (arrows). **B.** Ultrasound demonstrates a 6.5-cm mixed echogenicity periareolar collection in the left breast (calipers) associated with skin thickening, edema, and architectural distortion. Presentation is indicative of granulomatous mastitis

Fig. 4 **A.** A 65-year-old woman presents to the ED after a motor vehicle accident demonstrates a large hematoma throughout the right breast (arrow). **B.** Ultrasound demonstrates a 10.5-cm irregular mixed echogenicity mass/collection (calipers) with skin thickening of the left breast superiorly. Aspiration yielded 100 cc old blood



extremities, and scalp. When located in the breast, skin cysts are circumscribed dermal lesions in the periareolar, inframammary fold, parasternal, and axilla regions (Fig. 5A) [11]. On US, skin cysts appear as intradermal cystic, hypoechoic, or heterogenous circumscribed nodules [12]. The punctum is typically connected to a skin tract that may be seen on US (Fig. 5B). The “claw sign” refers to the posterior dermal line skin wrapping around the posterior edge of the dermal mass. Other imaging features include posterior acoustic enhancement and acute inflammation-related peripheral vascularity. A standoff pad or thickly applied transducer gel may be necessary to optimally visualize skin cysts on ultrasound given that even high frequency transducers (> 12 MHz) may not optically focus the most superficial 5–7 mm of the tissue [12].

As a general rule, core needle biopsy is not needed and in fact should be avoided to prevent fistulae formation the diagnosis of skin cyst can occasionally be difficult. The demonstration of internal vascularity or irregular margins raise suspicion for malignancy and biopsy may be required. In the more typical setting, surgical excision is favored over core needle biopsy [12].

Inflammatory breast cancer

Inflammatory breast cancer (IBC) is a rare and aggressive form of breast cancer. Symptoms evolve rapidly over the course of months and up to 20–40% of patients will have metastases to distant sites such as the brain, lungs, liver, or bone at presentation. Clinical findings include breast warmth, redness, tenderness, and enlargement that largely mimic inflammation, although there is no true inflammatory process involved. The breast may have a characteristic “peau d’orange” or “orange peel” appearance, which refers to the pitted, dimpled skin resulting from lymphatic obstruction by the tumor (Fig. 6). In order to properly diagnose inflammatory breast cancer, there must be evidence of clinical disease as well as tissue diagnosis of malignancy [13].

On US, imaging features overlap with mastitis and includes skin thickening, edema, and hypoechoic ill-defined parenchyma. Often a thorough clinical history, trial of antibiotic therapy, and close clinical follow-up are needed to differentiate the two. Unlike mastitis, women tend not to

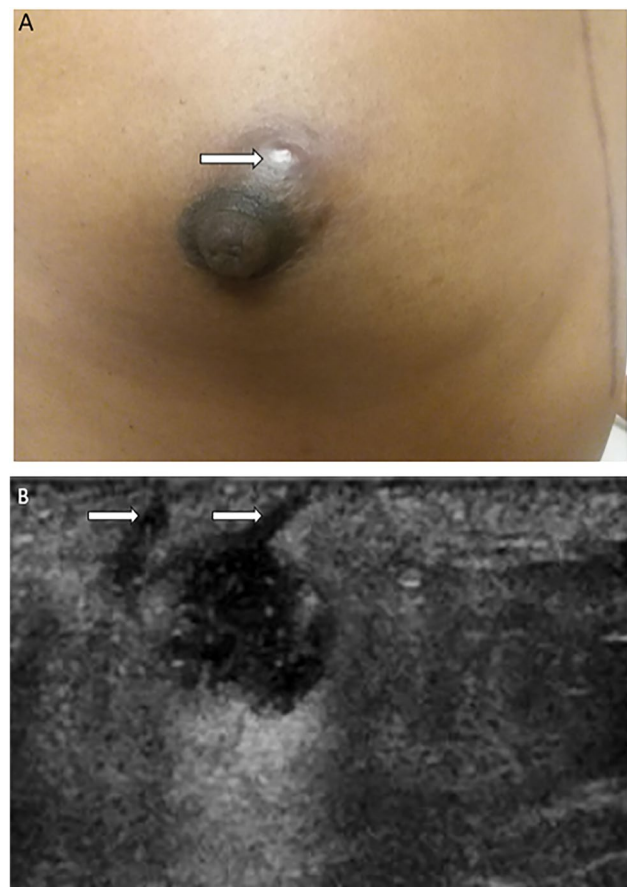


Fig. 5 **A.** A 45-year-old woman presents with a left breast areolar margin breast mass that contains a central punctum on visual inspection (arrow). **B.** Ultrasound demonstrates a 1.2-cm superficial mass with two sonographically-evident skin tracts (arrows). Findings are consistent with epidermal inclusion cyst



Fig. 6 A 46-year-old woman presents with left sided breast breast enlargement and skin dimpling consistent with peau d'orange. She had received two courses of antibiotics without improvement. Presentation is suggestive of inflammatory breast cancer

present with systemic symptoms such as fever or malaise, and pain is not always involved. Ultrasound's particularly important role for inflammatory breast cancer is in identifying biopsy targets and guiding percutaneous core biopsies [13]. Treatment involves a trimodal approach of neoadjuvant chemotherapy, mastectomy, and radiation.

Locally advanced breast cancer

Locally Advanced Breast Cancer (LABC) refers to breast tumors which have progressed locally but not spread beyond the breast and locoregional lymph nodes. LABC consists of a heterogeneous group of breast cancer histopathologies. LABC classically presents as a painless, large (> 5 cm) breast mass, although clinical characteristics may vary (Fig. 7A). It often presents with skin thickening, ulceration

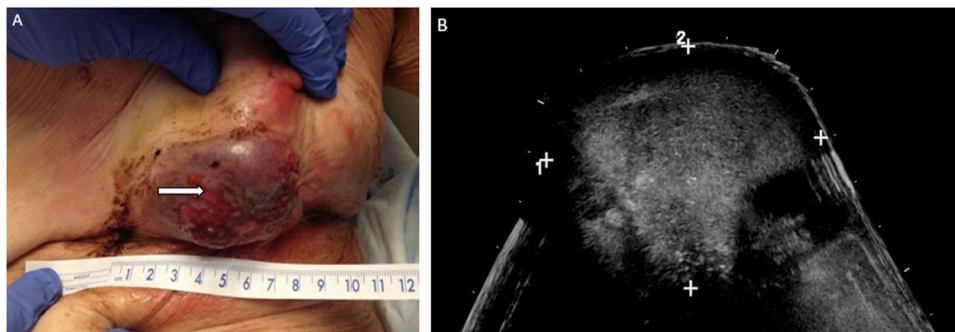


Fig. 7 A 79-year-old woman presented to the ED with no prior routine medical care and no significant medical history. She had burning discomfort under her left breast associated with an enlarging breast mass over the past year. **A.** In the ED, physical exam showed a fun-



Fig. 8 A 64-year-old woman presents with right nipple changes over two years; the patient recounts a slowly retracting right nipple with scaling and hardness (arrow) that had not responded to antibiotics or topical steroids. Findings were consistent with Paget disease of the nipple

and erythema, adenopathy, or chest wall involvement [14]. Bulky axillary lymphadenopathy is often present. The breast may be either shrunken or enlarged. LABC presents as an irregular mass on ultrasound (Fig. 7B) [15]. Imaging is often difficult to perform because of breast size, skin mass, or ulceration. Despite the advanced nature of the tumor, LABC is curable following a combination of chemotherapy, surgery, and radiation therapy [14].

Paget disease

Paget disease of the breast refers to a rare cancer of the nipple and areola that is commonly associated with an underlying breast malignancy. Clinically, Paget disease may present with pruritis, erythema of the nipple and areola, eczematous rash, nipple erosion or ulceration, scaly or flaky skin, nipple

gating bleeding left breast mass (arrow). **B.** Targeted US showed an approximately 6 cm fungating solid mass (calipers). Biopsy yielded invasive papillary carcinoma grade 2, triple positive. Findings were consistent with locally advanced breast cancer



Fig. 9 A 72-year-old woman with a history of a left lumpectomy 8 years prior presents to the ED with slowly growing purple dermal left periareolar breast mass unresponsive to topical medications over “several years” (arrow). Findings were compatible with angiosarcoma

retraction, and bloody discharge (Fig. 8). It is vital to perform a thorough breast exam on patients presenting with such symptoms, as these changes to the nipple and areola may be the only indication of an underlying malignancy. Furthermore, for patients with worrisome skin changes, a full-thickness biopsy of the nipple and areola should be performed in order to establish a diagnosis [16].

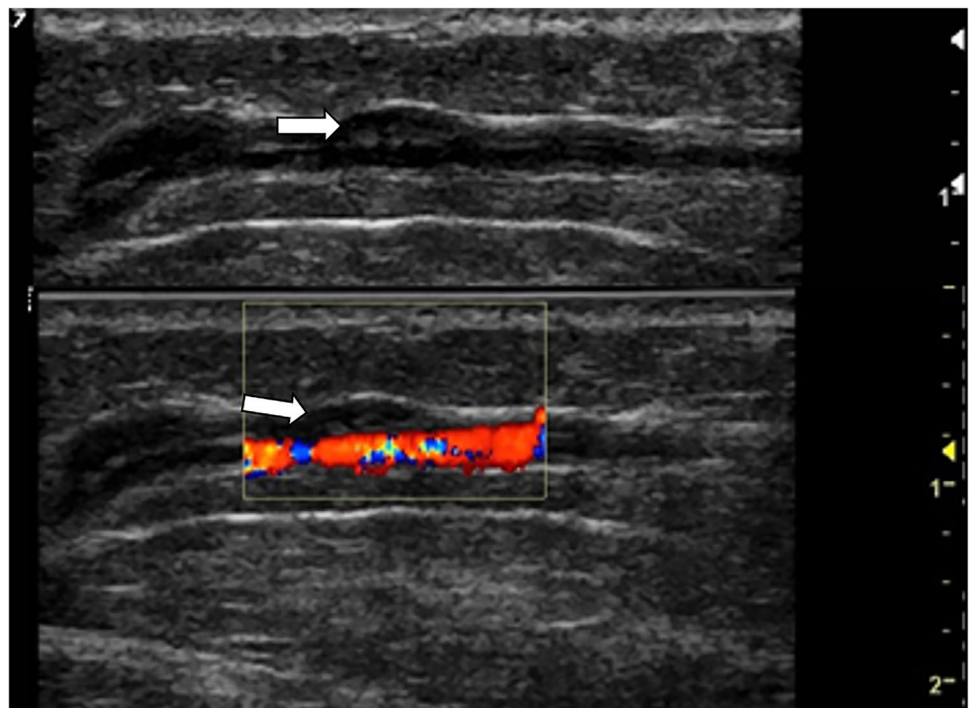
Ultrasonographic evaluation may demonstrate a discrete mass, microcalcifications, ductal ectasia, or morphologic

changes to the nipple-areolar complex, such as flattening, asymmetry, and thickening. Mammography demonstrates nipple, areolar, and subareolar abnormalities, such as skin thickening, nipple retraction, malignant calcifications, or a mass at the level of the nipple-areolar complex. Within the breast parenchyma, imaging may show a discrete mass or masses that demonstrate suspicious features, asymmetry, architectural distortion, or malignant calcifications elsewhere in the breast. Mastectomy, with or without axillary dissection, was historically the mainstay of treatment, but recent studies have shown that breast conserving therapy is a viable alternative [16].

Postradiation angiosarcoma

Postradiation angiosarcoma of the breast (previously known as secondary angiosarcoma) develops in the skin of the chest wall or scar of residual breast tissue in the irradiation field of previously treated breast carcinoma, arising with a mean latency period of 5–6 years. This dermal-based angiomatous pathology presents with solitary or multiple cutaneous red to violet plaques, patches, or nodules [17]. Older women are affected. The diagnosis, though near-pathognomonic in appearance, is often mistaken for bruising, mastitis, or benign dermatologic disease (Fig. 9). Eliciting the typical patient history and obtaining a skin biopsy together permit accurate diagnosis.

Fig. 10 Gray scale (top) and color (bottom) Doppler US findings are characteristic of superficial thrombophlebitis, with a partially recanalized beaded vein. Final diagnosis is Mondor’s disease



Mondor's disease

Mondor's disease is a benign, self-limited thrombophlebitis of a superficial vein presenting as subcutaneous cord-like induration evident clinically. Pathophysiologically, Mondor's disease is thought to be idiopathic, iatrogenic, or due to trauma [18]. Primary versus secondary Mondor's (due to trauma or hypercoagulability) should be distinguished in work up. On US, Mondor's disease presents as noncompressible hypoechoic tubular structures (Fig. 10). Treatment is conservative, to include oral nonsteroidal anti-inflammatory drugs. The disease typically resolves within two months [18].

Conclusion

There are ten distinct breast diseases readily diagnosed by clinical and ultrasound appearance that radiologists and sonographers may encounter in emergency room and urgent care patient presentations. Many electronic medical record systems incorporate photographs into patients' charts and emergency radiologists must adopt the practice pattern to routinely seek out clinical photographs while interpreting breast imaging exams.

Data availability (data transparency) Not applicable.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate IRB approval from the University of North Carolina (ID/AIR 18–01124: Principal Investigator Sheryl Jordan, MD). Informed consent, including the use of photographs for educational purposes, was obtained from all individual participants included in this study.

Consent for publication (include appropriate statements) Not applicable.

Conflict of interest The authors declare that they have no conflict interest.

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