Imaging Appearances and Differential Diagnosis of Idiopathic Granulomatous Mastitis

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1 Introduction

Idiopathic granulomatous mastitis (IGM) is a rare, benign, inflammatory process involving chronic lobulitis of the breast parenchyma. First described by Kessler and Wolloch [1], the condition is characterized by the presence of sterile noncaseating lobulocentric granulomata in the absence of a confirmed underlying diagnosis. Despite IGM being an essentially benign entity, the disease process can follow a rather unpredictable and aggressive course with persistent or recurrent episodes necessitating surgical intervention. Radiologically, IGM can mimic many other pathologies including breast carcinoma which has, in some cases, resulted in rather radical breast surgery including mastectomy. Patients can present with suspicious clinical findings suggestive of malignancy including a palpable firm breast mass which is the most common clinical presentation of IGM [2], nipple retraction, distortion of the breast contour, and ulceration as well as sinus formation.

The location and distribution within the breast are variable with reports of involvement of the breast periphery and subareolar location as well as more diffuse involvement. The majority of cases are unilateral with bilaterality reported between 1% and 9% [2].

In this chapter we aim to provide an overview of the varied imaging appearances of IGM in the context of the broad range of differential diagnoses. We hope that this will increase awareness of this disease entity thereby reducing the risk of delayed diagnosis and inappropriate management.

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H. Koksal, N. Kadoglou (eds.), *Idiopathic Granulomatous Mastitis*,
https://doi.org/10.1007/978-3-031-30391-3_8

2 Radiological Appearances

Mammography and ultrasound (US) are the main imaging modalities in the diagnostic workup but in selected cases magnetic resonance imaging (MRI) may also add valuable information. Patients younger than 40 years of age should have ultrasound (US) scans using a high-frequency linear probe as first-line investigation with discretionary mammography if the findings are thought to be suspicious. Patients over 40 years will usually receive both mammography and US. In both age groups, mammography is only used in the absence of pregnancy or breastfeeding at the time of presentation.

Appearances can be nonspecific and there are no radiological findings that are pathognomonic of IGM. Radiological appearances are usually that of an inflammatory process with a differential diagnosis including both benign and malignant pathologies. The radiologist's role is therefore critical to the diagnostic pathway in an attempt to exclude all other pathologies before a diagnosis of IGM can be made. Given the indiscriminate radiological findings, performing an image-guided biopsy is often the cornerstone of diagnosis. Historically, a fine-needle aspirate of the affected breast parenchyma has been performed for cytology; however, this is now considered inadequate and tissue sampling with a wide-bore biopsy needle is required for histological analysis. Subsequent multidisciplinary team (MDT) discussion is paramount to ensure clinical, radiological, and pathological concordance.

Once the diagnosis of IGM has been established, imaging continues to play a vital role in the management of this disease, for determining disease extent, aiding with presurgical planning, identification of abscess formation, evaluation of treatment response, and subsequent surveillance [2].

3 Mammography

One of the most common mammographic features of IGM is that of an asymmetric density which can appear either focal or diffuse. An ill-defined mass is another frequently encountered mammographic manifestation [2] (Figs. 1a–c and 2a–d).

The breasts may be asymmetric in size with the affected side being larger, demonstrating trabecular thickening and parenchymal edema. Skin thickening, parenchymal distortion, axillary adenopathy, and nipple retraction can also be mammographic features [2, 3] (Fig. 3).

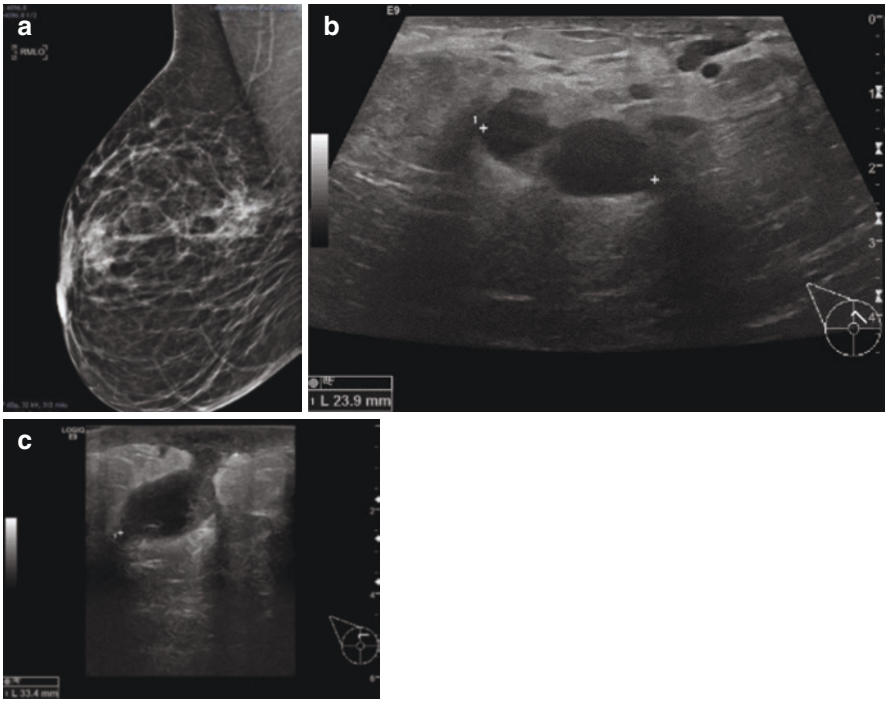

Fig. 1 (**a**) A 51-year-old woman with granulomatous mastitis. Mammograms show a right retroareolar ill-defined mass with a more posterior ill-defined asymmetry. (**b**) Ultrasound showing two focal inflammatory collections. (**c**) Retroareolar collection extending into the skin surface

Of note, inflammatory breast cancer which can present with similar clinical and imaging characteristics usually results in extensive dermal edema and inflammatory change which involves more than one-third of the breast [4]. By comparison, the dermal inflammatory change in IGM is rarely this extensive. Calcifications are an unusual radiographic feature of IGM [2]; however, segmental calcifications have occasionally been reported [5]. In some cases, mammography can appear entirely normal; however, in the case of particularly dense background glandular breast tissue or in the early stages of the disease process, a subtle mammographic abnormality can be masked.

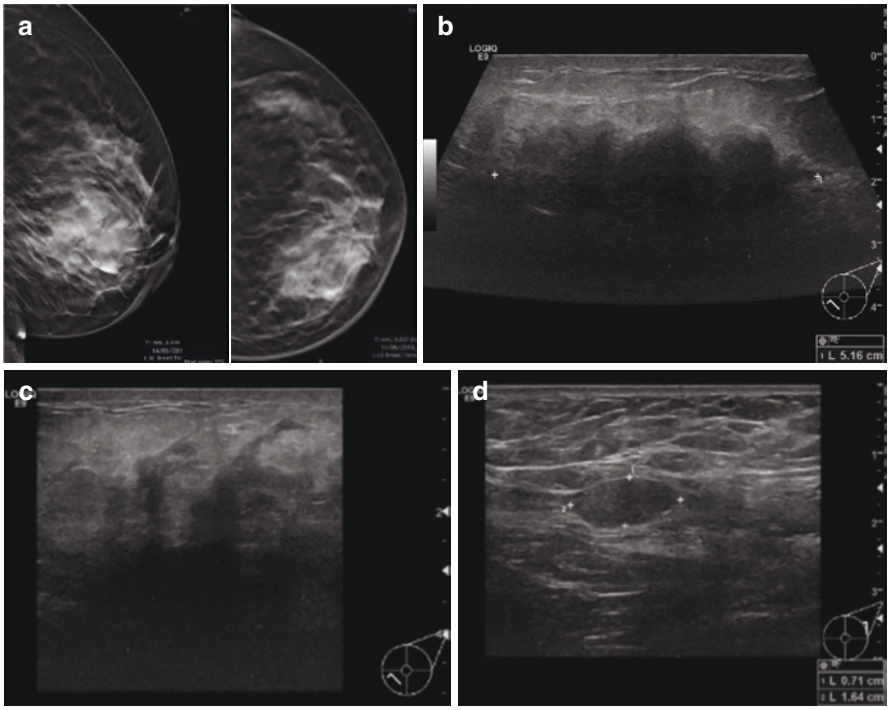

Fig. 2 (**a**) A 50-year-old woman with a firm mass in the left breast with nipple retraction suspicious for inflammatory carcinoma. Left: tomosynthesis images – there is dermal thickening and an ill-defined 85-mm retroareolar mass. (**b**) Ultrasound shows multiple hypoechoic mass lesions which are ill-defined. (**c**) This is associated with increased dermal thickening and increased echogenicity of the intramammary fat mimicking inflammatory carcinoma. (**d**) Enlarged left axillary nodes are also present. Core biopsy of the mass and axillary node showed granulomatous mastitis and reactive axillary adenopathy

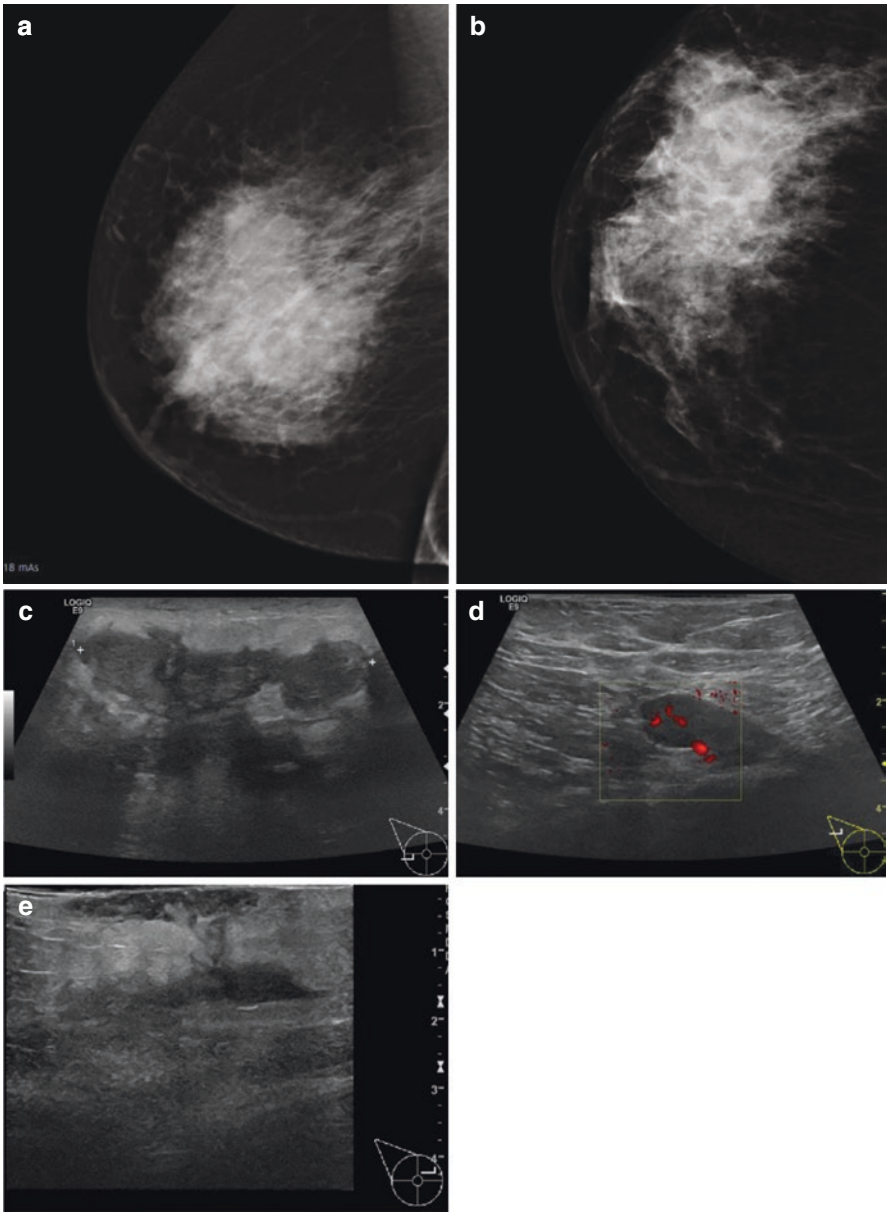

Fig. 3 (**a**, **b**) A 51-year-old woman with a 45-mm firm mass in the right breast with nipple retraction, peau d'orange, and suspicious adenopathy thought to be inflammatory carcinoma. Mammograms show an ill-defined 47-mm mass in the right breast. (**c**) Ultrasound shows a 55-mm ill-defined mass with surrounding inflammatory change and dermal thickening. (**d**) There are also abnormal right axillary nodes. (**e**) There was subsequent development of an inflammatory mass with a sinus tract extending into the skin. Core biopsy of the right breast and axilla shows granulomatous mastitis with negative screens for sarcoidosis and tuberculosis

4 Ultrasound

As with mammography, the sonographic appearances of IGM are varied. In early cases edema can be the only manifestation. US can demonstrate parenchymal heterogeneity and distortion [3] as well as ill-defined serpiginous hypoechoic areas which over time can become confluent to form masses. The most common finding on US is that of a hypoechoic irregular mass (Figs. 2 and 3) with peripheral hyperechogenicity. The mass often demonstrates tubular extensions [6] reflecting the propensity of IGM to interdigitate and insinuate between breast lobules rather than to engulf or destroy them [2] (Fig. 4). Posterior acoustic shadowing or enhancement is of little diagnostic relevance [2]. The pathological changes can occur in any quadrant of the breast but most commonly occurs in the retroareolar region (Fig. 5).

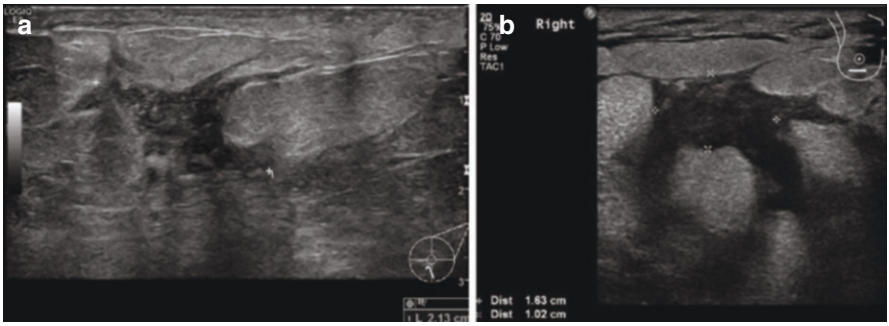

Fig. 4 Interdigitating extension of hypoechoic change between the fatty lobules on ultrasound. Hyperechoic change of the intramammary fatty lobules is also present. This appearance is nonspecific and represents diffuse inflammatory change. This can be present in IGM (4**a**) as well as lactational (4**b**) and non-lactational mastitis

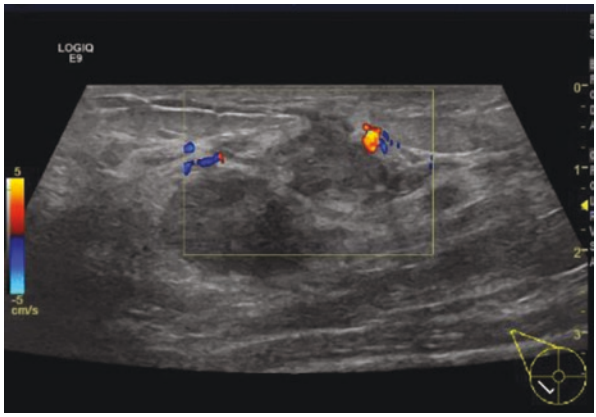

Fig. 5 A 43-year-old woman presenting with a right retroareolar mass with longstanding nipple inversion. Ultrasound-guided core biopsy showed granulomatous inflammation

The lesion and surrounding parenchyma are often edematous and can be hypervascular confirmed with Doppler imaging [5, 7]. Parenchymal heterogeneity [3], dermal thickening, and nipple retraction are common ancillary features (Fig. 2). In severe cases the patient can present with complex cystic collections and abscess formation which can be aspirated and a sample sent for microscopy, culture, and sensitivity as well as for cytology (Fig. 6). A sinus can develop, seen as an associated tract extending from the parenchymal hypoechoic inflammatory change to the skin surface (Fig. 7).

US can be helpful in the assessment of associated adenopathy (Figs. 2d and 3d). Enlarged lymph nodes can be present that demonstrate normal morphological appearances but with a thickened cortex in keeping with a reactive etiology.

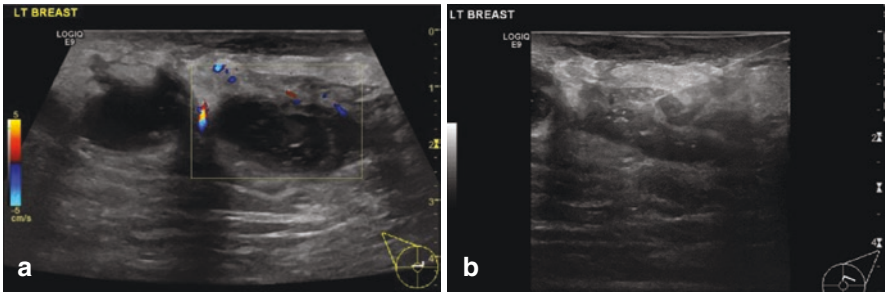

Fig. 6 (**a**) A 31-year-old woman with recurrent breast abscess. Ultrasound shows two collections with internal complex echoes with surrounding parenchymal inflammation with hypervascularity. (**b**) Ultrasound-guided aspiration

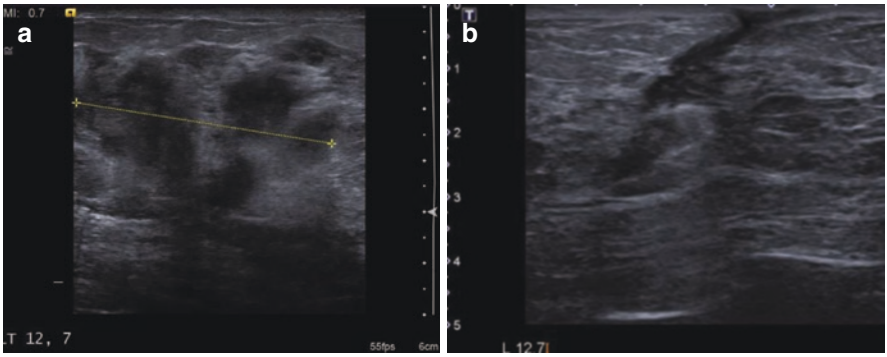

Fig. 7 (**a**) Sequelae of granulomatous mastitis. A 32-year-old woman presenting with painful diffuse lump in the left breast. (**b**) Subsequent development of a sinus tract 8 months later. There is an ill-defined hypervascular microlobulated mass in the 12:00 position of the left breast on ultrasound. Core biopsy confirmed granulomatous mastitis

5 Magnetic Resonance Imaging

Like other imaging modalities, MRI appearances of IGM can be variable and non-specific although MRI does appear to provide the best estimate of disease extent and contralateral breast involvement [8]. MRI is often utilized in the more challenging and refractory cases for monitoring disease progression and to assess response to treatment [2, 5]. IGM can be seen as irregular enhancing masses as well as asymmetric segmental non-mass enhancement. The largest case series by Yilmaz et al. [9] described heterogeneously enhancing masses as the dominant finding [10]. Diffuse non-mass enhancement is less commonly present [11]. IGM can also manifest as clustered well-circumscribed rounded lesions that are high signal on T2 and low signal on T1 with peripheral ring enhancement representing microabscess formation [5, 9, 10]. The majority of cases demonstrate a mixed enhancement pattern often with progressive wash-in and/or plateauing of the enhancement curve (Fig. 8) [12]. Regardless of the enhancement parametrics, the affected parenchyma is usually hyperenhancing compared with the normal breast tissue [8].

Accompanying perilesional edema, duct ectasia and periductal enhancement are recognized associations. Architectural distortion, sinus formation, and skin thickening are best visualized on T1 sequences. Oztekin et al. [12] found the majority (86%) of patients in a relatively small study of 29 patients to demonstrate a frank abscess; however, this is not a common finding in other centers.

Affected areas of the breast can demonstrate moderately restricted diffusion with consistently lower mean ADC values than the surrounding normal breast tissue [5, 8]; however, the use of restriction as a definitive diagnostic tool is of limited value in IGM [10].

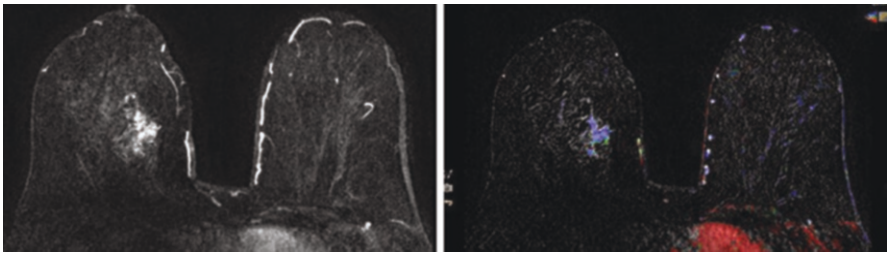

Fig. 8 A 54-year-old woman presenting with clinical suspicious 41-mm (US) breast mass in the upper inner quadrant of the right breast. Ultrasound-guided core biopsy showed benign histology (moderate chronic lymphoid infiltrate, no atypia or malignancy) felt to be discordant with the ill-defined type 1 non-mass enhancement on MRI. MRI-guided biopsy confirmed perilobular chronic mastitis

6 Computed Tomography

This modality is not a useful imaging tool in cases of IGM.

7 Other Conditions that Can Mimic IGM

7.1 Infective Mastitis

This is the most common cause of nonmalignant inflammatory breast disease in women of childbearing age and can be seen in both lactating and nonlactating women [2]. Imaging appearances of infective mastitis can be similar to IGM. Mammographic findings of both pathologies can be that of trabecular thickening and glandular asymmetry with parenchymal heterogeneity seen on US [2].

A spectrum of inflammatory change can be seen in both pathologies including subtle serpiginous pockets of fluid, complex coalescing fluid collections with mobile internal debris, or thick-walled, loculated formed abscesses, more likely to be seen in chronic or severe cases (Figs. 9, 10, 11 and 12). Patients who do not appear to respond to multiple courses of antibiotic therapy require investigation for infection caused by more atypical infections and to exclude other breast pathologies. By definition granulomatous mastitis should yield negative cultures [2].

Other forms of noninfective mastitis have similar imaging appearances (Figs. 13 and 14).

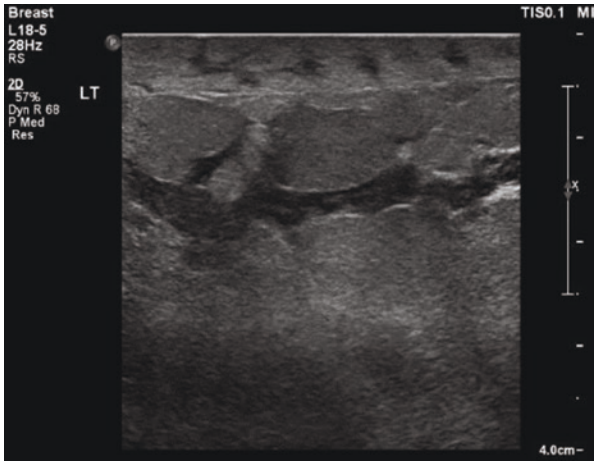

Fig. 9 A 41-year-old postpartum patient with left breast pain and erythema. Ultrasound confirms increased echogenicity with dermal and lymphatic thickening with no collection or abscess in keeping with mastitis

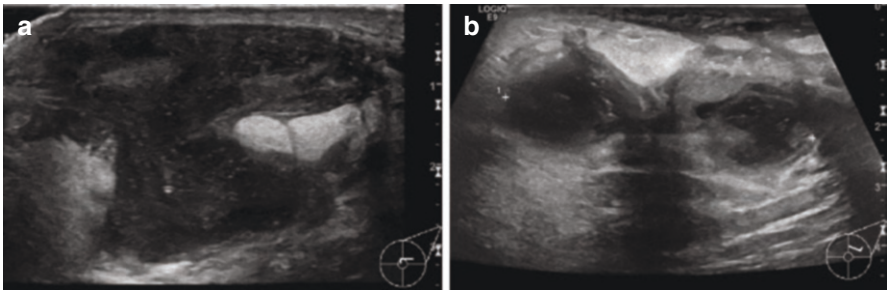

Fig. 10 (**a**) A 31-year-old breastfeeding patient presenting with a 4-week history of 41-mm complex lactational abscess. This was drained yielding heavy growth of *Staph. aureus* sensitive to flucloxacillin. (**b**) Improvement with follow-up scans and repeat percutaneous drainage

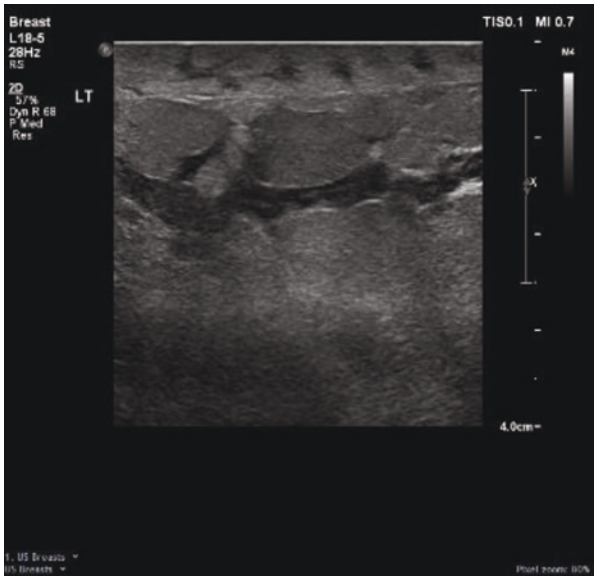

Fig. 11 A 33-year-old woman with right lactational mastitis showing interdigitating hypoechoic change between the fatty lobules against a background of increased echogenicity and dermal thickening

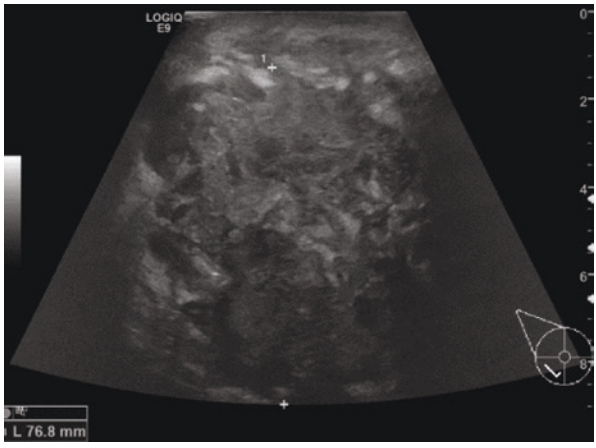

Fig. 12 A 26-year-old breastfeeding patient with a 2-week history of mastitis in the right breast. Ultrasound shows a large 70-mm complex collection confirmed to be an infected galactocele

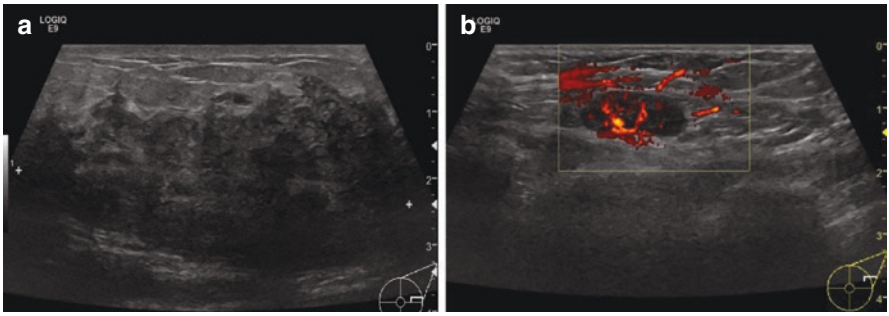

Fig. 13 (**a**) A 31-year-old woman presenting with a 5-day history of left breast swelling and pain. On ultrasound, there is a large 65-mm inflammatory mass occupying the lateral aspect of the left breast with no obvious collection. (**b**) Hypervascular enlarged nodes are also present. Core biopsy showed features in keeping with chronic mastitis with no granulomas

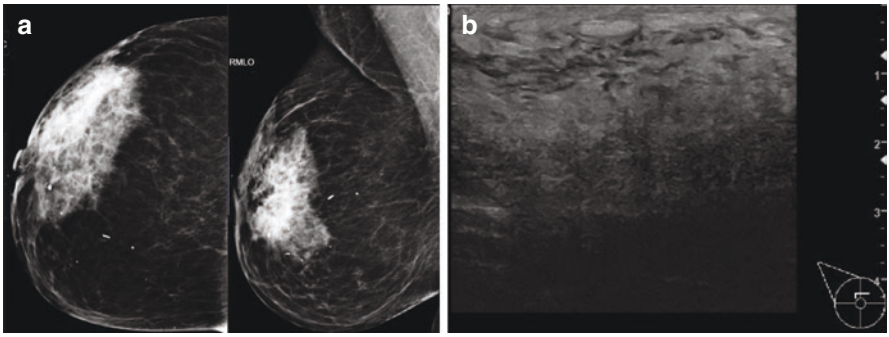

Fig. 14 (**a**) A 53-year-old woman presenting with 60-mm suspicious right retroareolar mass with right retroareolar asymmetry on mammography. (**b**) Diffuse inflammatory change centrally in the right breast on ultrasound. Core biopsy shows features in keeping with chronic mastitis. Subsequent follow-up confirmed complete clinical and imaging resolution

7.2 Periductal Mastitis

This is a form of mastitis occurring in nonlactating women and strongly associated with cigarette smoking. It most commonly affects women in their fourth decade but can affect all age groups and occasionally male patients [13]. The pathophysiology involves epithelial proliferation of the lactiferous ducts resulting in obstruction of secretions that can lead to infection often with *Staphylococcus aureus* and abscess formation. There is a propensity for infections to subsequently recur with mixed flora including anaerobic organisms that are more resistant to treatment. This can result in a more complex clinical course including fistulous tracts to the nipple areolar complex with a tendency for the infective changes to be centered on the periareolar region (Figs. 15 and 16) [13]. The radiological findings can be very similar to that of both IGM and inflammatory breast carcinoma. Periductal mastitis can been

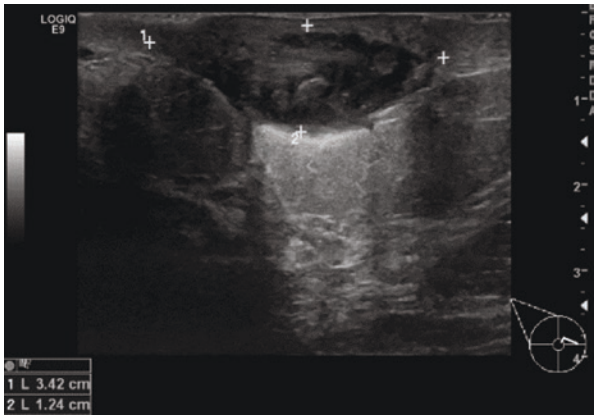

Fig. 15 A 36-year-old woman with recurrent right retroareolar collections in keeping with periductal mastitis

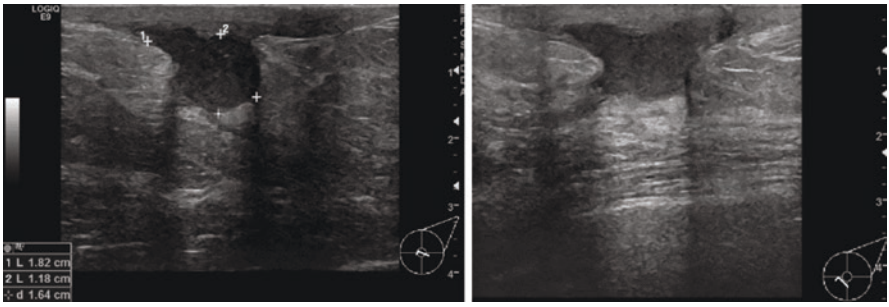

Fig. 16 A 41-year-old woman with recurrent left retroareolar collections. Periductal mastitis was confirmed on several biopsies

seen as a retroareolar opacity on mammography correlating with an ill-defined, mixed reflectivity collection on US. Reactive hyperemia can be present on US with surrounding parenchymal edema and dermal thickening. The sub areolar collection can be seen as a T2 hyperintense cystic mass on MRI which demonstrates peripheral enhancement on a postcontrast T1 fat-saturated subtracted sequence [13].

7.3 Tuberculous Mastitis

The prominent English surgeon Sir Astley Cooper [14] reported the first case of tuberculous mastitis in 1829 [15]. Multiparous and lactating women between the ages of 20 and 40 years are more frequently affected [15]; however, tuberculous mastitis is within the differential diagnosis of any patient presenting with diffuse inflammatory change within the breast, a painful mass, or abscess [16]. Both tuberculous mastitis and IGM can present with similar nonspecific radiological features; therefore, a clinical history of tuberculosis (TB) and/ or radiological manifestations

of systemic or pulmonary TB can be helpful in differentiating between the two disease entities.

Breast tuberculosis has been divided into five types: nodular tuberculous mastitis, tuberculous mastitis obliterans, sclerosing tuberculous mastitis, disseminated tuberculous mastitis, and acute miliary tuberculous mastitis [15, 17].

Radiologically, there are three subtypes of tuberculous mastitis with distinguishing imaging features: nodular, diffuse, and sclerosing [18].

Mammographic findings can include diffuse trabecular thickening, areas of asymmetric focal density, or mass lesions which can be either solitary or multiple. The nodular form of tuberculosis can manifest as either a heterogenous ill-defined mass concerning for malignancy or a well-circumscribed benign-appearing lesion with similar imaging appearances to a fibroadenoma [15, 16]. Seo et al. [19] found that the most common imaging presentation in both TB and IGM was that of a mass which in some cases had suspicious radiological features mimicking malignancy [2]. In a study by Kilic et al. [20], 43.5% of breast tuberculosis cases were found to have been reported as BI-RADS 4/5 lesions.

As the name suggests, the diffuse form of the disease manifests as a more infiltrative parenchymal asymmetric density on mammography. The sclerosing subtype is more likely to occur in older women and the imaging appearances reflect the underlying pathological process involving extensive fibrosis. This is seen on mammography as a dense breast mass, often accompanied by nipple retraction and reduction in breast volume [15] (Fig. 17).

Sonographic features of both TB and IGM are similar to other granulomatous disorders of the breast as well as to malignancy. Parenchymal hyporeflectivity with surrounding inflammatory change, dermal thickening, solitary or multiple masses, and/or complex cystic collections are common findings of both entities. Communication can be seen between the masses in both TB and IGM as well as sinus tract formation extending to the skin surface [16]. The nodular subtype has similar US features to that seen on mammography presenting with a mass that can have either irregular or well-defined margins [15]. Confluent ill-defined masses can be seen in the diffuse form of tuberculous mastitis. Heterogeneous parenchyma with increased reflectivity but in the absence of a mass is a more common finding in the sclerosing subtype [15].

On MRI tuberculous mastitis tends to demonstrate a background of nonspecific parenchymal enhancement with edema and dermal thickening. More lesional ill-defined mass like areas of inflammatory involvement can be seen which demonstrate rapid contrast uptake and plateauing of the enhancement curve on T1-weighted imaging [15]. Abscess formation is typically hyperintense on T2 with peripheral ring enhancement and central necrosis. Sinus formation and fistulation are both well visualized on MRI and fistulous extension into deeper tissues can also be more clearly depicted, particularly on the T1 sequence [15].

Ancillary findings of tuberculous mastitis include coarse calcifications, skin thickening, duct ectasia, nipple retraction, and lymphadenopathy [16]. The presence of calcified axillary lymph nodes can help to differentiate TB from IGM or malignancy [18].

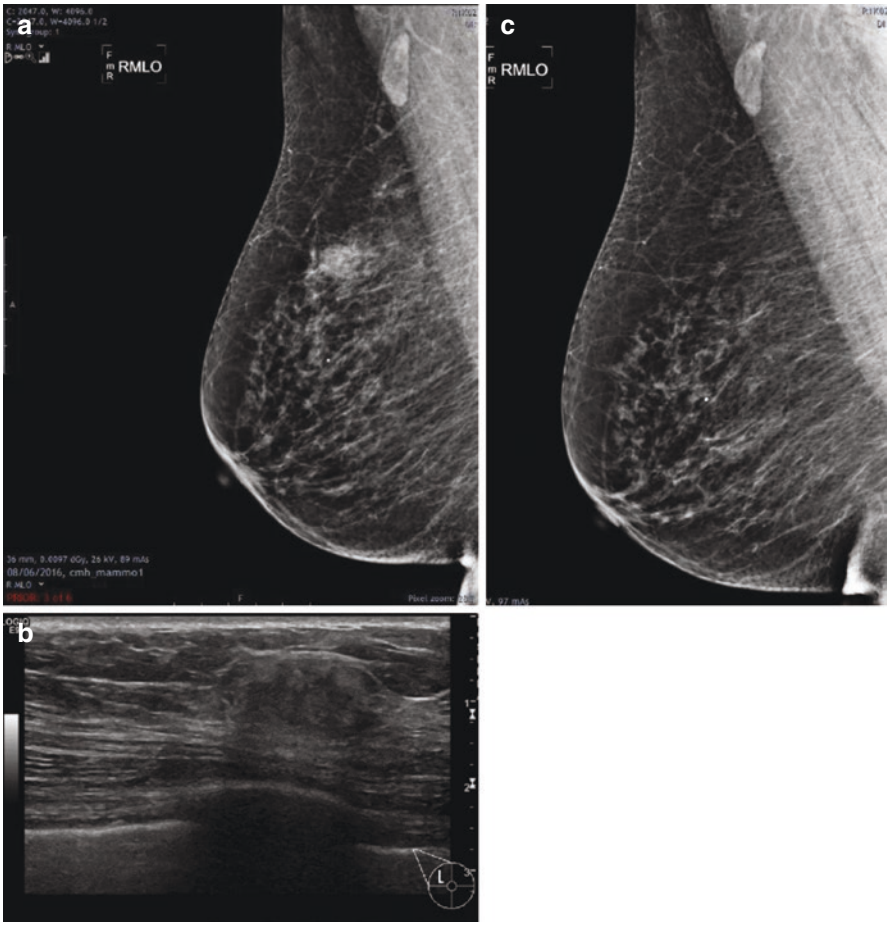

Fig. 17 (**a**) A 57-year-old woman with previous left breast cancer. Mammograms show a new ill-defined mass in the right upper outer quadrant. (**b**) A 20-mm ill-defined mass on ultrasound thought to be a new malignant mass. Core biopsy showed changes in keeping with granulomatous mastitis. Further core biopsies were performed for microbiological cultures and stainings, TB cultures, and 16S rDNA PCR test to diagnose TB. (**c**) Right mammogram showing full resolution of the mass a year later following antituberculous treatment

The axillary lymph nodes in TB are likely to be enlarged and can demonstrate cortical thickening; however, the margin of the involved nodes tend to be smooth and regular with a normal fatty hilum and preservation of the nodal architecture. These appearances are therefore more likely to reflect a benign or reactive/inflammatory etiology rather than a malignant process. In particularly severe cases of TB mastitis, a confluent nodal mass can form in the axilla which can be centrally necrotic and which has the potential to form a sinus tract to the overlying skin surface.

Diagnosis is usually confirmed by tissue sampling of the affected breast detecting acid-fast bacilli on Ziehl-Neelsen staining or cultures or performing a 16S rDNA PCR test.

7.4 Sarcoidosis

Sarcoidosis is a disease of the immune system which can affect any organ or system [2]. Breast involvement is rare, occurring in less than 1% of patients with systemic sarcoidosis [21]. Sarcoidosis most commonly affects young females and can present as a firm, hard breast mass in the context of involvement of other organs and in the presence of a raised angiotensin-converting enzyme [21]. Unilateral or bilateral, irregular or spiculate masses are the most common finding on mammography [22]. Ill-defined hypoechoic masses are the most common US presentation although small well-defined masses have also been described. Interestingly, calcifications are typically not seen [21, 22]. Irregular heterogeneously enhancing masses can be seen on MRI demonstrating type 2/3 enhancement parametrics.

7.5 Malignancy

As previously described, the most common clinical symptoms of IGM include an asymmetrically enlarged breast, erythema, edema, unilateral palpable breast mass, nipple retraction, and axillary lymphadenopathy. These signs and symptoms are also frequent presenting features of breast malignancy, in particular inflammatory breast carcinoma which is defined as a histological diagnosis of malignancy in the context of a clinically apparent inflammatory process. The similarities between these two entities mean that they are often clinically and radiologically indistinguishable (Figs. 18 and 19).

Extensive dermal edema and trabecular thickening seen on both mammography and sonography can occur in both inflammatory breast cancer and IGM, but are seen less commonly in the latter [2]. Breast mass, asymmetric density, and distortion are imaging findings common to both disease processes and are less discriminatory [2]. The presence of an abscess and/or sinus tract can be a useful diagnostic feature favoring an underlying diagnosis of IGM rather than malignancy.

As with other imaging modalities, similar MRI features can be present in both IGM and malignancy, and therefore, MRI cannot be used to confidently distinguish between these two pathologies. Both disease processes can manifest as heterogeneously enhancing masses on dynamic T1 fat-saturated sequences; however, a malignant pathology is more likely to demonstrate early wash-in of contrast with rapid washout compared with plateauing of the enhancement curve seen with

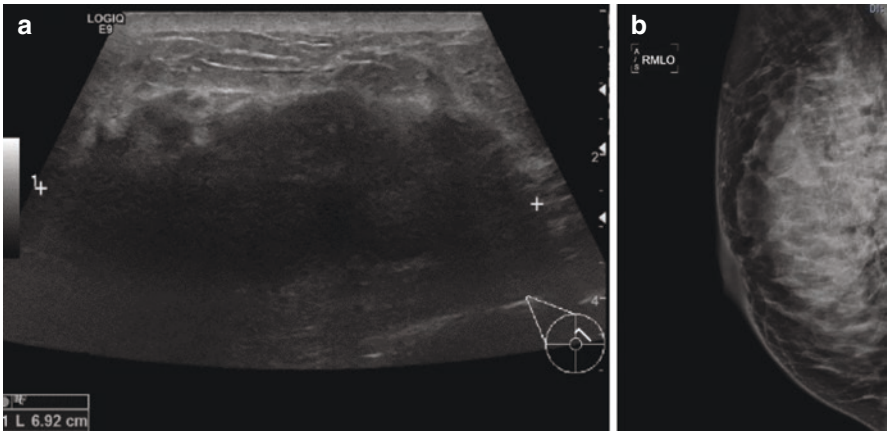

Fig. 18 (**a**) A 32-year-old woman who is 12 weeks' pregnant presenting with inflammatory change in her right breast thought to be an abscess. Core biopsy showed node-positive grade 2 invasive ductal carcinoma ER4/8 PR2/8 HER2 positive. (**b**) Mammography shows diffuse edematous change and skin thickening in keeping with inflammatory breast cancer

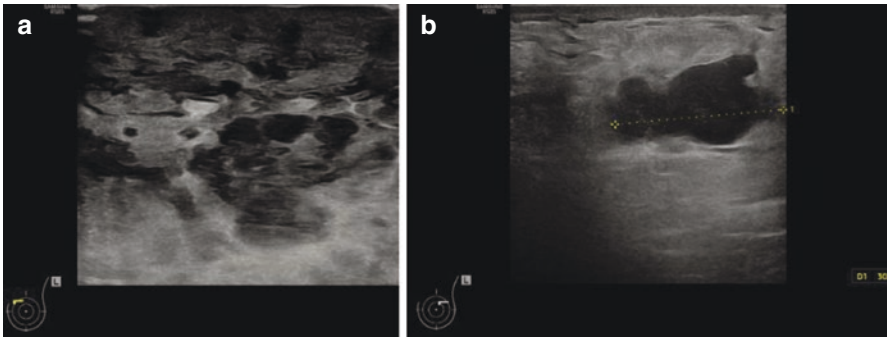

Fig. 19 An 86-year-old woman presenting with peau d'orange and enlarged left breast thought to represent a locally advanced breast cancer. Ultrasound shows (**a**) dermal and subcutaneous nodules and inflammatory change as well as (**b**) multiple lobulated masses. Core biopsy shows this to be lymphoma

IGM. Asymmetric and/or segmental non-mass enhancement is another common MRI finding of both pathologies [2]. The mass lesions seen in IGM are commonly rim enhancing with a smooth margin. This observation was supported by Poyraz et al. [23] whose study confirmed that the mass lesions seen in IGM are more likely to be well defined and rounded with rim enhancement rather than the ill-defined, irregular masses most likely to be seen in malignancy.

If breast malignancy is associated with nodal involvement, the lymph nodes can have pathological imaging appearance. Such features include nodal enlargement, rounded morphology, and loss of the normal nodal architecture with cortical effacement. The nodes in IGM are characteristically enlarged; however, they are more likely to exhibit a normal morphology with preservation of the fatty hilum.

7.6 Diabetic Mastopathy

Diabetic mastopathy is a relatively uncommon benign condition occurring in patients with a long history of insulin-dependent diabetes mellitus characteristically in premenopausal women approximately 20 years after the onset of their diabetes [13, 22]. Such patients tend to present clinically with large, firm, non-tender solitary, or multiple breast masses that can sometimes be bilateral. Both the clinical findings and imaging appearances of diabetic mastopathy are often concerning for and indistinguishable from malignancy (Fig. 20).

Both IGM and diabetic mastopathy can present with irregular masses or heterogeneous asymmetric densities on mammography. Diabetic mastopathy is more commonly bilateral when compared with either IGM or breast malignancy. Hypoechoic masses or ill-defined areas of hyporeflectivity can be seen on US, often with significant posterior acoustic shadowing [13]. There is limited published data on MRI findings of diabetic mastopathy; however, the most frequently encountered appearances are seen to be that of patchy parenchymal enhancement [24]. Given the nonspecific imaging characteristics, tissue sampling is warranted to distinguish between the breast pathologies.

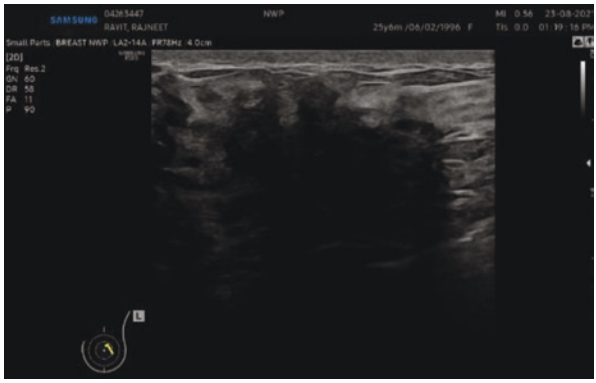

Fig. 20 A 35-year-old insulin-dependent diabetic patient with painful inflamed lump in the left breast. Ultrasound shows an ill-defined heterogeneous lobulated hypoechoic mass. Core biopsy confirmed diabetic mastopathy

7.7 Mastitis in Other Autoimmune Conditions

Autoimmune mastitis has only relatively recently been described in the literature with increasing numbers of case reports suggesting that this condition has previously been underdiagnosed. Many autoimmune conditions with multisystem involvement also have the potential to manifest as breast pathology. Autoimmune mastitis includes a wide range of disease entities including Wegener's granulomatosis, IgG4 disease, Sjogren's disease, Crohn's disease, systemic lupus erythematosus, thyroiditis, eosinophilic mastitis, and amyloidosis [25]. The clinical presentation of autoimmune mastitis can be varied ranging from minimal symptoms to recurrent episodes of severe inflammation and discharging abscess. Dermal involvement, nipple retraction, and lymphadenopathy have also been reported [25]. Radiological appearances are often similar to IGM and can include a focal mass or can present as a more diffuse nonspecific imaging finding.

8 Conclusion

In summary, IGM is a rare benign inflammatory condition of the breast characterized by noncaseating granulomatous formation without an attributable cause. IGM commonly occurs in premenopausal women and has a spectrum of nondiscriminatory imaging appearances mimicking both benign and malignant conditions resulting in a prolonged and tortuous diagnostic path. The diagnosis of IGM is one of exclusion and can therefore only be established after imaging-guided tissue sampling has eliminated other causes of inflammatory breast diseases (Fig. 21). Correlation with clinical history and examination findings as well as MDT discussion are vital in establishing the correct diagnosis and treatment plan. This helps to ensure that cases of malignancy are diagnosed in a timely fashion and that benign pathologies are appropriately treated rather than being subjected to radical surgical intervention.

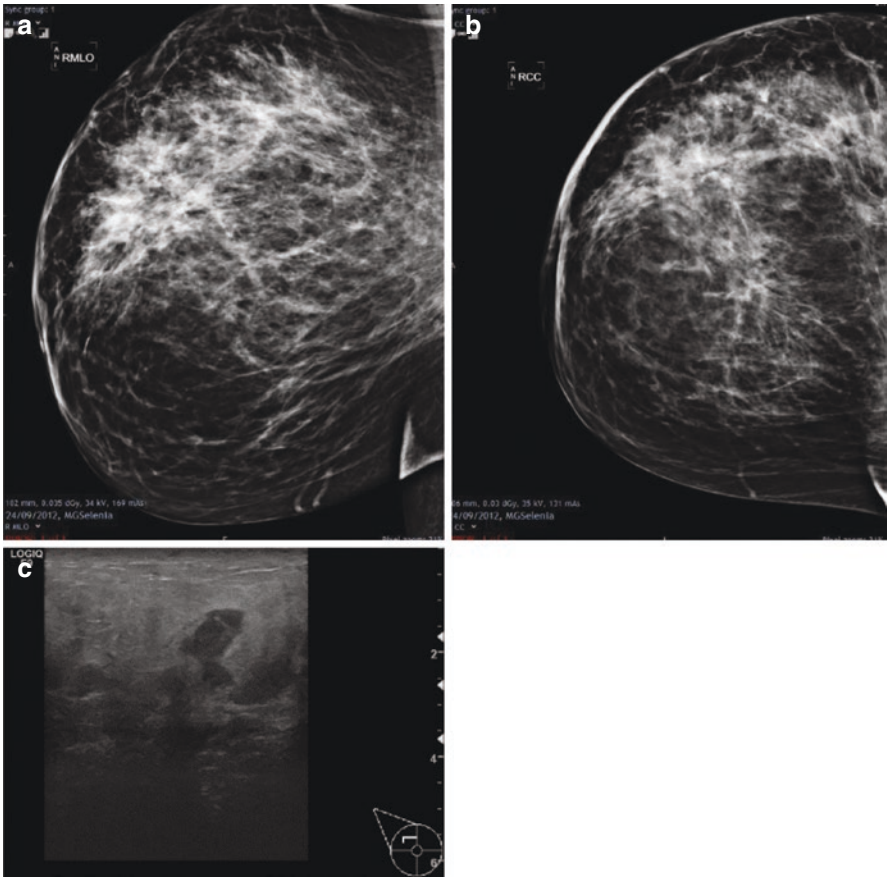

Fig. 21 (**a**, **b**) A 38-year-old woman presented with diffusely tense, red, and swollen right breast. Mammograms show diffuse thickening of the dermis associated with increased trabecular pattern and asymmetrical density in the superior and lateral aspect of the right breast. (**c**) Ultrasound shows right upper outer quadrant diffuse edema of the dermis and intramammary fat associated with thickening of Cooper's ligaments associated with multiple hypoechoic lesions. Core biopsy confirms granulomatous mastitis. (**d**, **e**) Mammograms later show normal right breast

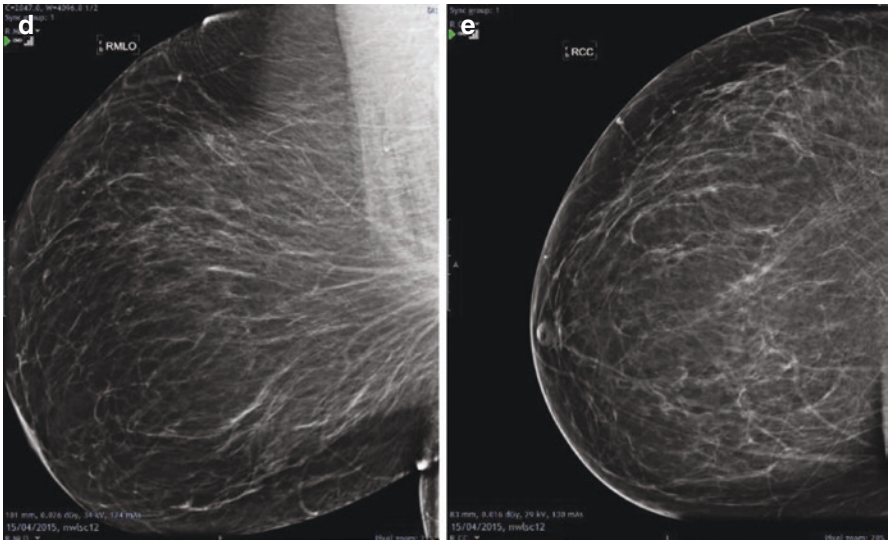

Fig. 21 (continued)

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