Imaging Findings in Idiopathic Granulomatous Mastitis

A Review With Emphasis on Magnetic Resonance Imaging

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Objective: To describe magnetic resonance (MR) imaging features of patients with a histologic diagnosis of idiopathic granulomatous mastitis (IGM).

Methods: Dynamic contrast-enhanced MR imaging was performed with a 1.5-T MR unit. Postprocessing of images included subtraction and calculation of time-intensity curves of the enhancing regions at several points in all patients.

Results: In addition to granulomatous inflammation, biopsy slides of 5 patients demonstrated abscess formation without a specific organism (aseptic abscess). One patient had a fibrotic tissue component. Magnetic resonance imaging findings were heterogeneously enhancing areas with (n = 5) and without (n = 1) multiple ring-like enhanced abscesses and a circumscribed lesion with heterogeneous contrast enhancement (n = 1). Time-intensity curves showed a benign pattern in all but 1 patient.

Conclusion: Idiopathic granulomatous mastitis has a number of appearances on MR imaging. Magnetic resonance imaging with measurement of time-signal intensity curves may support the findings of ultrasonography and mammography in distinguishing benign inflammatory breast disorders from malignant ones; however, biopsy still remains the only method of definite diagnosis.

Key Words: breast, mastitis, granulomatous mastitis, breast abscess, magnetic resonance imaging

(*J Comput Assist Tomogr* 2004;28:635–641)

Idiopathic granulomatous mastitis (IGM) is an infrequent chronic inflammatory breast disease of unknown etiology. Kessler and Wolloch[1] first described this entity in 1972 as breast masses characterized by florid granulomatous mastitis that was not associated with granulomatous infections, trauma, or foreign body reactions. Some histopathologic forms such as diffuse and sclerosing forms of IGM may be confused clinically and radiologically with fibroadenoma, fibrocystic changes, or carcinoma.[2,3] To date, approximately 120 cases have been reported in the international literature. In most reported cases, the patients are parous women who usually presented during lactation or within 6 years of pregnancy.[2,4–7] Clinical and histopathologic findings of IGM have been well documented.[5,8] Mammography (MG) and ultrasonography (US) findings of this condition have been relatively well described; however, there are only a few case reports evaluating magnetic resonance (MR) imaging features.[6,7,9,10] Our aim is to evaluate the MR imaging features of IGM.

SUBJECTS AND METHODS

We have used MR imaging in the evaluation of breast disease since 1997 at our hospital. We retrospectively reviewed the clinical and imaging findings, including MG, US, and MR imaging, of 7 women who met the required histopathologic criteria of IGM between January 1997 and December 2003. Some of the patients had been referred from peripheral government hospitals.

All patients had undergone US and MR examination before the MR imaging. We routinely use MG in patients older than 35 years of age. Four patients were younger than this; however, because of clinical and US concerns of malignancy, we performed MG in these patients to detect possible microcalcifications. Craniocaudal and mediolateral-oblique projection mammograms were obtained in a dedicated breast unit. Breast US was performed with a linear 5–12-MHz transducer. Magnetic resonance examinations were performed in a 1.5-T MR unit by using a dedicated breast coil with the patient in the prone position. Magnetic resonance imaging performed before the administration of contrast material comprised transverse T1-weighted and transverse T2-weighted fast spin echo imaging. The images were obtained with 5-mm thick sections, 1.0-mm gaps, and a 256 × 192 matrix with 2 to 3 signals acquired. After the initial examination, dynamic contrast-enhanced images were obtained by using a T1-weighted, dynamic, 3-dimensional, fast low-angle shot sequence; 256 × 192 matrix; and 5-mm section thickness with a 1.0-mm intersection gap. A bolus of gadopentetate dimeglumine was injected intravenously by hand at a dose of 0.1 mmol/kg of body weight within

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TABLE 1. Summary of Histopathologic Findings and Corresponding US and MR Imaging Features

	US Findings			MR Imaging Findings		
Histopathologic Findings	Hypoechoic Masses With Tubular Extensions (n = 5)	Hypoechoic Lesion With Significant Acoustic Shadowing (n = 1)	Hypoechoic Areas With Sound Through Transmission (n = 1)	Heterogeneously Enchancing Regions With Multiple Ring-Like Enhanced Lesions (n = 5)*	Circumscribed Heterogeneously Enhanced Lesion (n = 1)	Patchy Areas With Contrast Enhancement (n = 1)
Noncaseous granulomas, inflammatory cells, and abscess formation (n = 5)	+			+		
Noncaseous granulomas and inflammatory cells (n = 1)			+			+
Noncaseous granulomas, inflammatory cells, and fibrosis (n = 1)		+			+	

*One patient in this group demonstrated malignant type time-signal intensity curves.

10–15 seconds, followed by a 10-mL saline solution flush. Sequential multisection whole-breast images were obtained in the transverse plane at 60-second intervals for 5 minutes. Postprocessing of images included subtraction and calculation of time-intensity curves of the enhancing regions at several points in all patients. All images were assessed by 3 radiologists by means of consensus.

The diagnoses were confirmed with US-guided core biopsy. Previously performed fine needle aspiration cytology was negative for malignancy in 3 patients. In 5 patients, biopsies were obtained from the mass-like areas and tubular connections. Slides were examined; special stains and cultures of sample tissue and blood were performed; and a complete blood cell count and measurement of C-reactive protein levels were included. We also assessed the chest radiographs of the patients. Steroid therapy was then begun for all patients.

RESULTS

The patients ranged in age from 28 to 41 years (mean, 35 years) at the time of presentation. Our patients were diagnosed within 8 years (mean, 4.5 years) of their last pregnancy. Presenting symptoms were palpable and painful mass in all patients. Three patients had also skin thickening, and 1 of these patients had nipple retraction. The preliminary clinical diagnoses were breast abscess (n = 2) and malignancy (n = 5). Three of the lesions occurred in the right breast, whereas 4 others occurred in the left breast.

Histopathologic, US, and MR imaging findings of the patients are summarized in Table 1. The histopathologic diagnosis was granulomatous mastitis in the patients. Common histopathologic findings were necrotic areas and noncaseous granulomatous inflammation within the breast lobule. Granulomatous inflammation comprised Langerhans type multinucleate giant cells, epithelioid histiocytes, and eosinophils. Inflammatory cells such as neutrophils and lymphocytes were also noted (Fig. 1). Biopsy slides of 5 patients demonstrated abscess formation without a specific organism (aseptic abscess). One patient had a fibrotic tissue component. All special stains for microorganisms and polymerase chain reaction for tuberculosis DNA were negative. White blood cell counts were normal, and C-reactive protein levels were found to be elevated. There were no malignant cells or fungi, and specimen and blood cultures were negative. The chest radiographs were normal.

Mammography findings of our patients were nonspecific and revealed a focal asymmetric density without a distinct

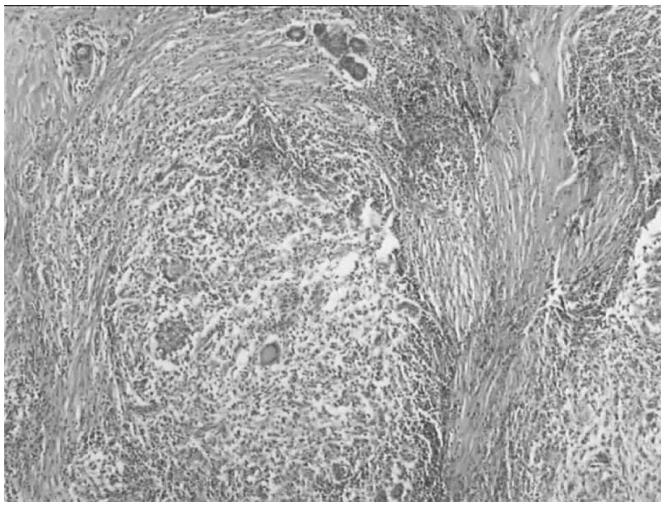

FIGURE 1. Biopsy specimen shows granulomas and accompanying lymphocytic infiltration (hematoxylin–eosin, 10×).

margin (n = 2; Figs. 2A, B), diffusely increased breast density at the affected site (n = 3), and a dense parenchymal pattern without abnormal finding (n = 2). None of the breasts showed malignant calcification on MG.

On US, 5 of the patients had shared features, including hypoechoic indistinctly bordered heterogeneous masses, which were connected by a few tubular hypoechoic structures (see Fig. 2C). These masses had weak posterior sound through transmission. Corresponding MR images of these 5 patients also had common characteristics and revealed segmental heterogeneity, which was hypointense on precontrast T1-weighted images and hyperintense on T2-weighted sequences. Postcontrast dynamic T1-weighted scans showed heterogeneously enhancing areas, including multiple ring-like enhanced abscesses (see Figs. 2D, E; Figs. 3A, B). Abscess walls revealed a benign type time-signal intensity curve (gradual and progressive enhancement without washout); however, in 1 case, heterogeneously contrast enhanced areas also showed a malignant type time-signal curve (early peak enhancement and washout; see Fig. 2E). In 1 patient, irregularly bordered hy-

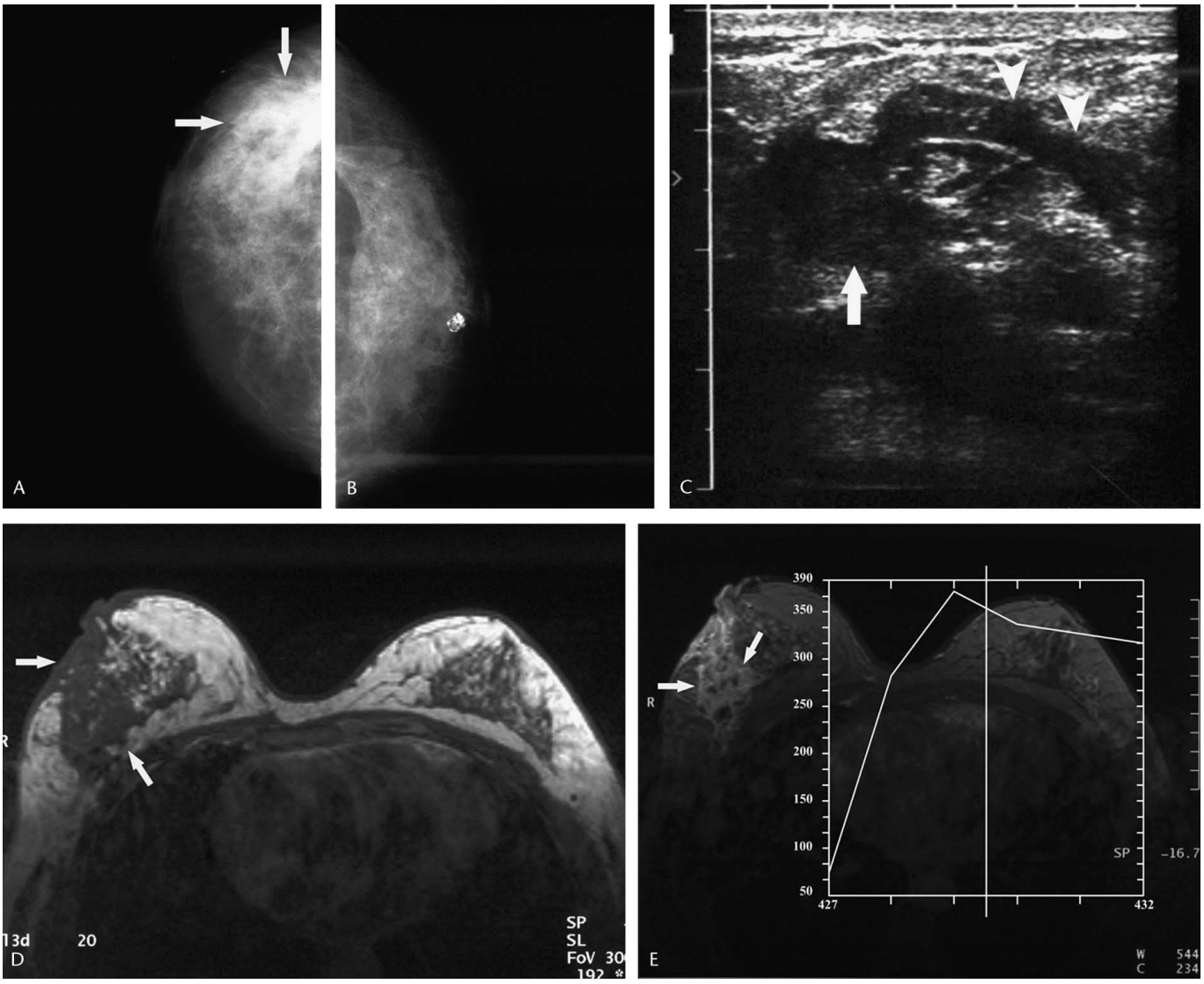

FIGURE 2. A 41-year-old woman with a palpable mass in the outer upper quadrant of the right breast. Craniocaudal mammography of the right (A, arrows) and left (B) breasts demonstrates an asymmetric irregular opacity on the right breast. An incidental benign finding of retroareolar calcification was also noted on the left breast. C, Ultrasonography of the lesion shows an irregular, hypoechoic lesion (arrow) that has a tubular extension (arrowheads). Precontrast (D) and postcontrast (E) T1-weighted magnetic resonance images reveal a segmental hypointense area (arrows) that enhances heterogeneously after intravenous contrast administration. Skin thickening and nipple retraction are also noted. Some centrally hypointense and ring-shaped enhanced lesions consistent with abscess are present. A time-intensity curve shows early peak enhancement and washout.

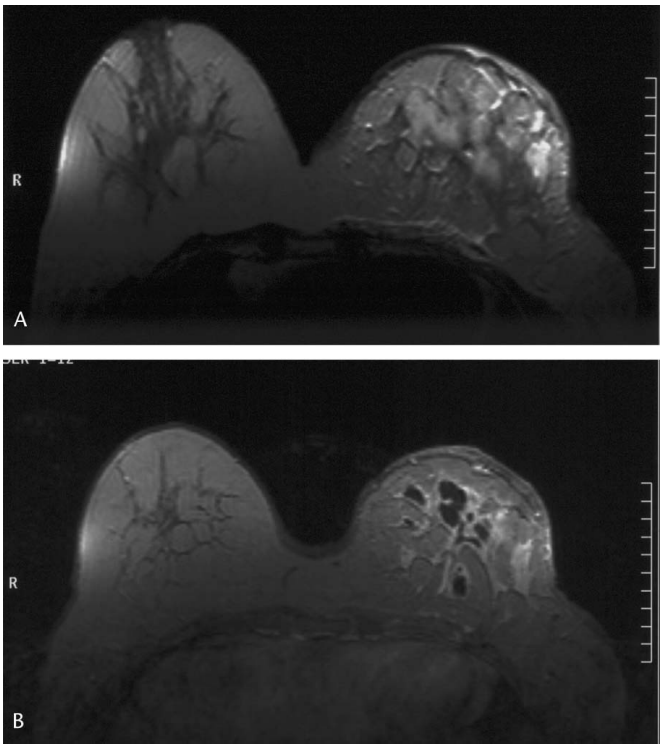

FIGURE 3. A 37-year-old woman with a mass in her left breast. T2-weighted (A) and postcontrast T1-weighted (B) MR images demonstrate diffuse irregular hyperintense areas on a T2-weighted scan and multiple, lobulated, ring-like enhanced abscesses on a T1-weighted scan. Skin thickening was also noted.

poechoic lesions were detected on US. The corresponding MR image was consistent with the US findings and showed hypo- and hyperintense signal on precontrast T1- and T2-weighted images, respectively. Unlike the other patients in this group, diffuse enhancement was observed without ring-like enhancement on a contrast-enhanced series in this patient (Fig. 4). We

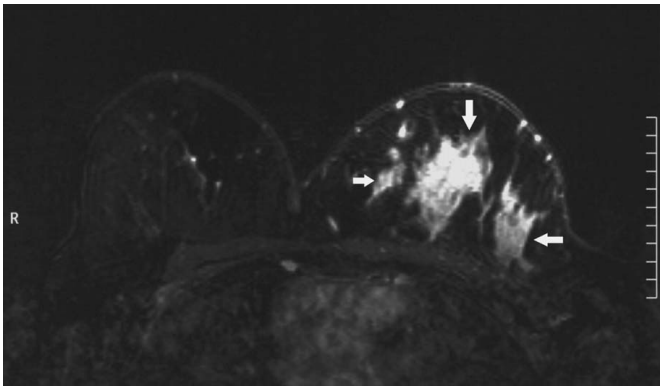

FIGURE 4. A 34-year-old woman with left breast masses. A subtraction image reveals irregular contrast-enhanced lesions (arrows).

obtained benign type time-intensity curves from these areas. In another patient, US showed focally decreased parenchymal echogenity and marked acoustic shadowing at the painful and palpable site (Fig. 5A); MR images showed a circumscribed

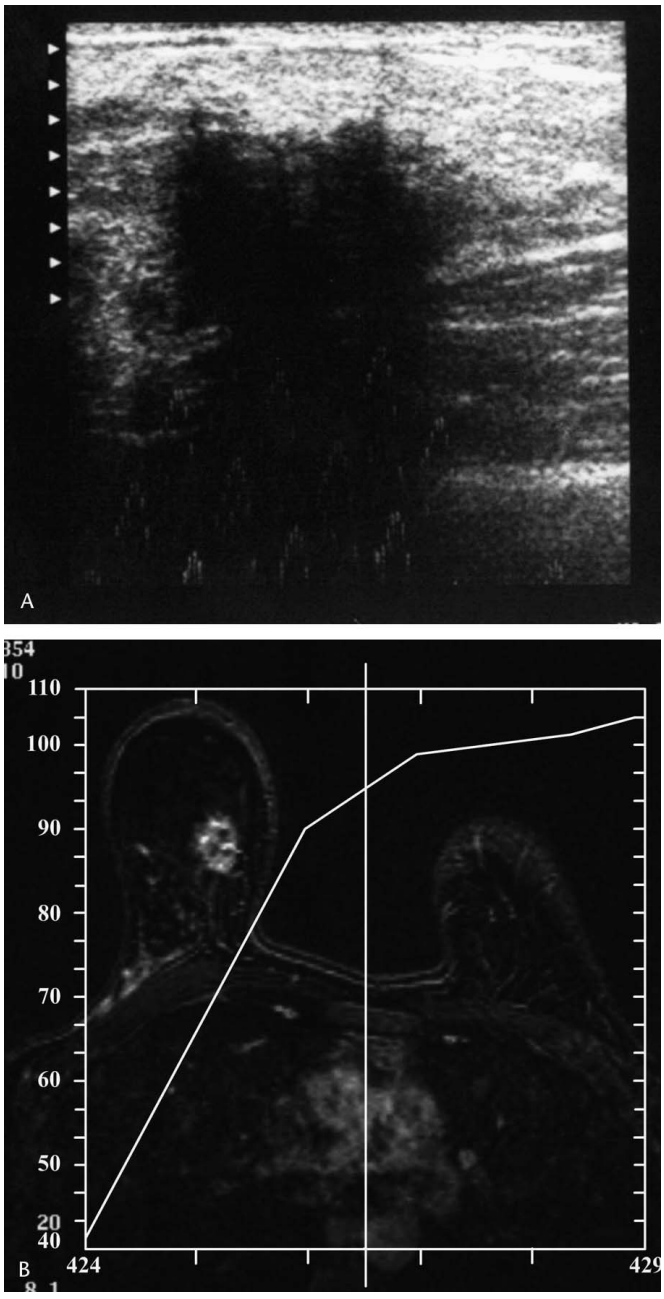

FIGURE 5. A 31-year-old woman with a painful right breast mass. A, Ultrasonography reveals an irregular hypoechoic mass with marked posterior shadowing suggesting malignancy. B, Subtraction image obtained of unenhanced image from third contrast-enhanced T1-weighted magnetic resonance image demonstrates a heterogeneously enhanced oval mass with an irregular border. A time-intensity curve represents progressive enhancement without washout.

lesion with heterogeneous enhancement (see Fig. 5B). This patient also showed a benign time-signal intensity curve.

In addition to these imaging findings, all techniques consistently demonstrated skin thickening in 3 patients and nipple retraction in 1 of these patients. We have not observed axillary lymph node enlargement in our patients. Recurrence occurred in 2 cases, and the patients underwent surgical excision.

DISCUSSION

Idiopathic granulomatous mastitis is an uncommon benign breast disease characterized by a chronic, noncaseous, necrotizing granulomatous lobulitis with or without abscess formation. It has been postulated that IGM results from a localized autoimmune response to the extravasated fatty and proteinous secretions in the duct. Microorganisms and oral contraceptives are other postulated causes; however, the etiology is still unknown.[1,5,8] This entity is usually unilateral, and regional lymphadenopathy may be present in up to 15% of cases. The patients are usually of child-bearing age, ranging from 17 to 42 years. Most of the women were diagnosed within 6 years of their last pregnancy.[3,5,6,7,11]

Idiopathic granulomatous mastitis is a diagnosis of exclusion. In addition to the demonstration of characteristic histopathologic findings, exclusion of possible histopathologic conditions such as duct ectasia, fat necrosis, foreign body reaction, and granulomatous inflammation (eg, sarcoidosis, tuberculosis, histoplasmosis, Wegener granulomatosis) is necessary. Idiopathic granulomatous mastitis also has radiologic mimickers, including malignancy, abscess, and necrosis. The recommended treatment of IGM is complete resection or open biopsy with corticosteroid therapy. Nevertheless, in several patients who were treated by surgery, recurrence has occurred and repeated surgery has been needed. Complications such as fistulas and abscess formation may also develop as a result of the disease itself and/or surgical interventions.[3,7,8]

Clinical, histopathologic, MG, and US features of IGM have been described relatively frequently.[2,4,8] Imaging findings in the literature are summarized in Table 2. Low sensitivity caused by dense breast tissue limits the value of MG in this age group. In patients having dense breast parenchyma, MG may be negative,[2,3,4,11] Although asymmetric density in MG is not a specific finding, the most common reported finding of IGM was an asymmetrically increased density without a distinct margin or mass effect. Additionally, small, multiple, ill-defined masses have been described without microcalcification. Our results are similar to those nonspecific MG findings. We also found US results similar to those of previous reports.[2,3,4,11] Tubular hypoechoic structures connecting to the ill-defined masses were the predominant finding, and an irregular hypoechoic lesion with marked posterior acoustic shadowing suggesting malignancy was seen in 1 patient.

Magnetic resonance imaging characteristics have been reported in only a few cases in the literature.[6,7,9,10] Schelfout et al[7] demonstrated nonspecific focal homogeneous enhancing masses with irregular margins, suggesting malignancy or inflammation. Van Ongeval et al[6] showed 2 different irregularly enhancing lesions in the involved breast, in which the enhancement was ring-shaped in 1 lesion. Although the time-intensity curve of the ring-shaped enhanced lesion was of a benign pattern, the other lesion demonstrated a malignant type time-intensity curve. Cakir et al[9] reported another case in which an irregularly bordered and markedly enhancing lesion with a benign type time-intensity curve was evident. In another case, Sakurai et al[10] reported a case in which all imaging methods suggested malignancy.

Our cases demonstrated different MR patterns. The most frequent pattern was segmental, heterogeneous, contrast-enhancing areas with multiple ring-like abscess formation. None of our patients showed microorganisms. Abscess formation has been described previously in either an aseptic form or a septic form as a secondary complication.[11,12] Aseptic abscesses have been reported in some other autoimmune diseases such as ulcerative colitis and Crohn disease.[13,14] We suggest that a possible autoimmune mechanism is responsible for aseptic abscesses, which can be seen in a phase of the IGM. We found that different imaging appearances reflect the different stages and histopathologic findings such as the degree of inflammatory reaction and fibrotic content in 2 patients. In all but 1 patient, benign time-signal intensity curves were revealed. The presence of a benign time-signal intensity pattern in all but 1 patient suggests that contrast dynamic is the potential decisive factor to differentiate benign from malignant conditions.

Because of its diffuse inflammatory pattern, IGM should be included in the differential diagnosis of inflammatory breast conditions such as inflammatory breast carcinoma, abscess, and fat necrosis. Based on the previously mentioned clinical and MR features, abscess cannot be differentiated from some patterns of IGM. The MG and US spectrum of fat necrosis resembles both benign and malignant conditions. Fat necrosis also demonstrates a wide spectrum of MR imaging findings such as irregular and early enhancement, spiculated enhancement, and ring-shaped enhancement without washout.[15] Fat necrosis may occur as a result of radiation therapy, trauma, or some surgical interventions. Without a clinical history, it is difficult to differentiate IGM from fat necrosis.

The differential diagnosis of IGM from inflammatory breast carcinoma is also a diagnostic difficulty. Breast edema, enlargement, and skin thickening have been reported as common clinical and imaging features of inflammatory breast carcinoma.[16] Time-signal intensity curves in inflammatory breast carcinoma are variable. Demonstration of abscess formation has led to the diagnosis of a benign inflammatory condition, however, because the possibility of an abscess harboring malignancy is rare.[17] Moreover, the frequency of abscess formation in inflammatory breast carcinoma has been reported as

TABLE 2. Review of the US, MG, and MR Imaging Findings of IGM in the Literature

	US	MG	MR Imaging*
Schelfout et al[7] (n = 1)†	Not performed	Asymmetric diffuse increased density	Focal irregular homogeneously enhanced masses
Van Ongeval et al[6] (n = 1)	Inhomogeneous hypoechoic lesion with posterior acoustic shadow	Bilateral diffuse increased density of the fibroglandular tissue	An irregular ring-shaped enhanced lesion with a gradual and progressive enhancement and another one with early enhancement pattern followed by washout
Cakir et al[9] (n = 1)	Inhomogeneous hypoechoic lesion with posterior acoustic shadow	Unilateral diffuse increased density	Heterogeneously enhanced irregular lesion and gradual and progressive enhancement without washout
Sakurai et al[10] (n = 1)	Irregular hypoechoic mass	Ill-defined asymmetric density with amorphous calcification	Irregularly enhanced mass without contrast washout
Memis et al[3] (n = 15)	Irregular hypoechoic mass with tubular extensions (n = 5), tubular-multinodular hypoechoic areas (n = 6), and hypoechoic areas with acoustic shadowing (n = 4)	Asymmetric opacities (n = 11) and negative (n = 4)	Not performed
Kara et al[12] (n = 1)	Well-defined hypoechoic areas with tubular extensions	Asymmetric densities with skin thickening	Not performed
Engin et al[2] (n = 10)‡	Heterogeneous hypoechoic masses (n = 3), circumscribed opacities, and abscess cavities with sinus tracts (n = 7)	Circumscribed opacities (n = 3), asymmetric dense parenchyma, nodular opacities (n = 2), parenchymal distortion (n = 1), and bilateral dense parenchyma (n = 1)	Not performed
Yilmaz et al[11] (n = 12)	Heterogeneous hypoechoic areas with/without tubular extensions (n = 6), hypoechoic irregular mass (n = 1), and edematous breast with skin thickening (n = 1)	Focal asymmetric density without mass formation (n = 8), irregular masses (n = 3), and negative (n = 1)	Not performed
Han et al[4] (n = 9)§	Tubular hypoechoic lesions (n = 5) and oval hypoechoic masses with hypoechoic tubular connections (n = 2)	Multiple small ill-defined masses (n = 3) and local asymmetric density (n = 3)	Not performed

*When compared with glandular tissue, all lesions are hypointense on T1-weighted images and hyperintense on T2-weighted images.
†Time-signal intensity curve not obtained.
‡In 3 patients, MG not performed.
§In 2 patients, US not performed; in 3 patients, MG not performed.

10% of cases.[16] Noninflammatory malignancies also show ring enhancement in the presence of necrosis; however, they have an irregular rim and usually are not multiple. In the absence of central necrosis, early rim enhancement usually progresses in a centripetal fashion.

Idiopathic granulomatous mastitis is rare; hence, the number of patients in this study prevents us from making generalizations. This condition has a number of appearances on MR imaging. Magnetic resonance imaging with measurement of time-signal intensity curves may support the US and MG findings in distinguishing benign inflammatory breast disorders from malignant ones; however, biopsy still remains the only method of definite diagnosis. Magnetic resonance spectroscopy could be the next step in differentiation between malignant and benign disorders with the measurement of choline levels and differentiation between infectious and noninfectious conditions with the documentation of some amino acids.

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