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Assessment and Management of Challenging BI-RADS Category 3 Mammographic Lesions[1]

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Abbreviations: BI-RADS = Breast Imaging Reporting and Data System, CC = craniocaudal, IDC = invasive ductal carcinoma, MLO = mediolateral oblique

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SA-CME LEARNING OBJECTIVES

After completing this journal-based SA-CME activity, participants will be able to:

- Recognize breast lesions that are acceptable to place in short-term follow-up and those that should be recommended for biopsy.
- Describe probably benign lesions with use of proper BI-RADS descriptors.
- Identify the evolutional patterns of benign breast lesions that undergo interval change.

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Breast Imaging Reporting and Data System (BI-RADS) category 3 lesions are probably benign by definition and are recommended for short-interval follow-up after a diagnostic workup has been completed. Although the original lexicon-derived BI-RADS category 3 definition applied to lesions without prior imaging studies (when stability could not be determined), in clinical practice, many lesions with prior images may be assigned to BI-RADS category 3. Although the BI-RADS fifth edition specifically delineates lesions that are appropriate for categorization as probably benign, it also specifies that the interpreting radiologist may use his or her discretion and experience to justify a "watchful waiting" approach for lesions that do not meet established criteria. Examples of such lesions include evolving masses or calcifications suggestive of prior trauma and instances when stability cannot be ascertained because of image quality. Although interval change is an important feature of malignancy, many benign lesions also change over time; thus, use of prior imaging studies and ongoing imaging surveillance to demonstrate the evolution of a probably benign lesion is justified. Some examples of common pitfalls associated with inappropriate BI-RADS category 3 assessment include failure to use proper BI-RADS descriptors, failure to perform a complete diagnostic workup, and overreliance on negative ultrasonographic findings. When appropriately used, short-interval follow-up saves many patients from undergoing biopsy of benign lesions, without decreasing the rate of cancer detection.

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Introduction

The Breast Imaging Reporting and Data System (BI-RADS) category 3 classification "probably benign" was implemented to reduce the number of biopsies for false-positive imaging findings while maintaining a high detection rate for early-stage cancer. The American College of Radiology BI-RADS lexicon states that probably benign lesions should carry a 2% or lower likelihood of malignancy (1,2). Lesions should be placed in this category only after a full diagnostic breast imaging evaluation. The follow-up protocol includes a 6-month unilateral diagnostic examination followed by 12- and 24-month bilateral diagnostic examinations. If the lesion is stable, the patient may then return to yearly screening mammography. At our institution, diagnostic radiologists personally discuss all initial BI-RADS category 3 assessments with patients at the time of diagnostic evaluation, explaining the significance of a BI-RADS category 3 assessment, the likelihood of malignancy, and the need for close surveillance. Proper use of the BI-RADS category 3 classification should decrease the number of biopsies performed, as only 0.9%–7.9% of probably benign lesions are ultimately upgraded to require biopsy (3–6). Therefore, use of this approach may increase the cost-effectiveness and efficacy of screening mammography.

TEACHING POINTS

- In routine practice, lesions that do not necessarily ascribe to these categories are placed into BI-RADS category 3. This is considered an acceptable practice, as the fifth edition of the BI-RADS lexicon states that other lesions can be considered probably benign "if the radiologist has personal experience to justify a watchful-waiting approach." Such lesions may include the following: *(a)* developing calcifications that appear to be most likely, but are not definitely, vascular; *(b)* calcifications suggestive of early evolving fat necrosis; and *(c)* lesions in which evaluation of stability is difficult because of technical differences between studies (for example, comparing analog to digital examinations or using equipment from different vendors).
- If a benign-appearing solid mass demonstrates growth, interval change trumps or supersedes benign morphology, and biopsy is warranted despite probably benign features.
- Within the appropriate clinical or imaging context (ie, developing calcifications potentially due to the same process as other clearly benign calcifications in the breast), short-term imaging follow-up may be a reasonable alternative to immediate biopsy. An interval increase in the number of calcifications that is not consistent with evolving benign causes or any development of more suspicious morphology should prompt biopsy.
- After posttreatment changes have stabilized, any new changes should be scrutinized carefully and should be considered potentially suspicious for recurrence.
- Screening mammograms alone are not sufficient to enable classification of a BI-RADS category 3 lesion. In the BI-RADS fifth edition, one of the modifications explicitly states that the term *probably benign* should not be used at screening mammography; it should be used only after imaging workup of screening-detected findings.

Mammographic findings suitable for short-term follow-up include *(a)* noncalcified solid masses with a round or oval contour and at least 75% circumscribed margins, *(b)* a solitary group of round microcalcifications, and *(c)* focal asymmetries without associated calcifications or architectural distortion (3–6) (Fig 1). However, in routine practice, lesions that do not necessarily ascribe to these categories are placed into BI-RADS category 3 (7). This is considered an acceptable practice, as the fifth edition of the BI-RADS lexicon states that other lesions can be considered probably benign "if the radiologist has personal experience to justify a watchful-waiting approach" (1). Such lesions may include the following: *(a)* developing calcifications that appear to be most likely, but are not definitely, vascular; *(b)* calcifications suggestive of early evolving fat necrosis; and *(c)* lesions in which evaluation of stability is difficult because of technical differences between studies (for example, comparing analog to digital images or using equipment from different vendors) (8).

This article explores challenging clinical situations in which an initial diagnosis of BI-RADS category 3 was made. Some of these lesions were appropriately classified as BI-RADS category 3 lesions; however, in others, the BI-RADS category 3 classification was misused. Some lesions demonstrate typical probably benign findings; in other cases, the radiologist must use his or her discretion and experience to place an atypical or challenging lesion into BI-RADS category 3. We present these cases as a learning tool for radiologists who encounter similar challenging clinical scenarios and to highlight common pitfalls associated with inappropriate BI-RADS category 3 assessment.

Change Weighed against Benign Morphology

Masses

Fat necrosis is a benign entity that typically occurs after breast trauma, surgery, or radiation therapy. Often, however, a history of trauma may not be elicited, which can create a diagnostic dilemma because the mammographic appearances of fat necrosis range from characteristically benign to highly suspicious for malignancy. When fat necrosis manifests at mammography, it may take the form of a focal asymmetry, a focal dense mass, or an irregular spiculated mass (9). Solid-appearing components are related to fibrosis that produces a desmoplastic reaction (10). Fat necrosis typically involutes over a relatively short time. Malignant causes should be suspected when the mass does not evolve into a typically benign appearance or if it increases in size (Fig 2). Thus, when fat necrosis is suspected in the setting of a new mass lesion, a shorter follow-up interval should be recommended. The BI-RADS fifth edition recommends repeat mammography after 1 month when the clinical history and imaging findings are suspicious for recent breast trauma or infection (1). In our clinical experience, we have found that a 6–8-week follow-up interval is helpful in revealing a measurable change, and we use this slightly longer interval for follow-up when fat necrosis is suspected.

Hematomas typically do not have benign mammographic features such as well-circumscribed margins; however, in the proper clinical context, a suspected hematoma may be recommended for short-term follow-up instead of biopsy if the location of the injury corresponds to the location of the mass (Fig 3). The mammographic appearance varies, but hematomas appear most commonly as a radiodense mass with poorly defined margins (11). On US images, a hematoma manifests as a heterogeneous mass that initially appears hyperechoic and subsequently becomes smaller and more hypoechoic over time (12). Hematomas typically resolve within 2–4 weeks; however, they can

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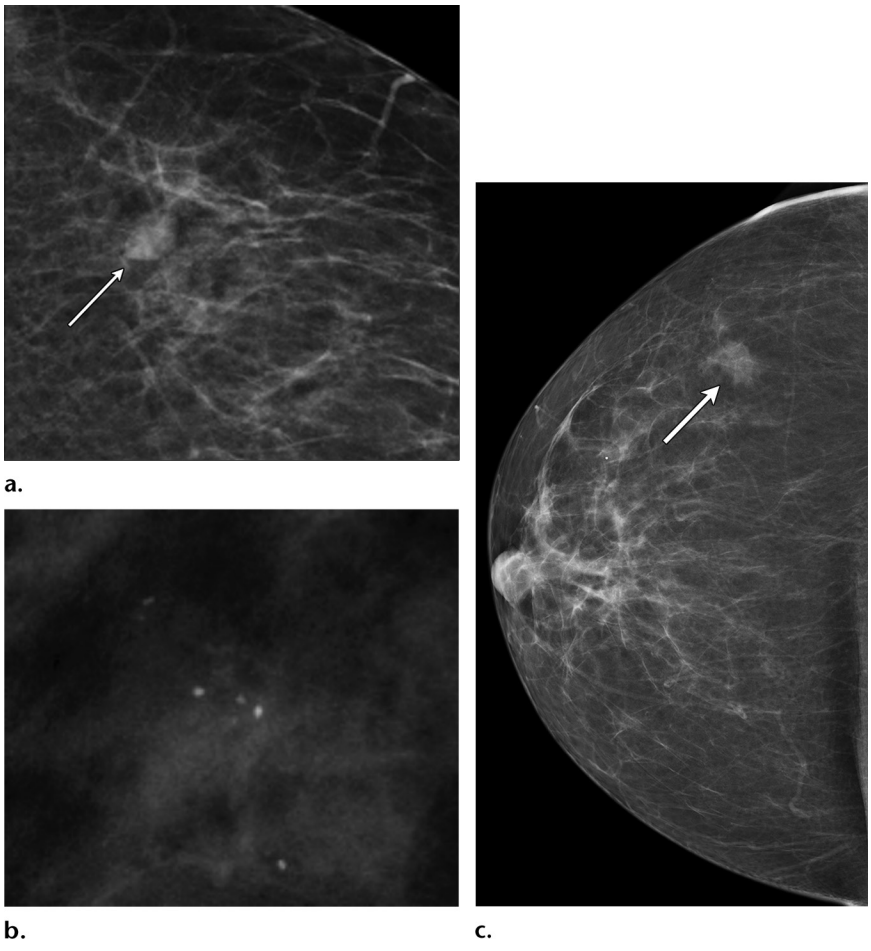


Figure 1. Mammographic findings suitable for short-term follow-up per BI-RADS criteria. **(a)** Mediolateral oblique (MLO) image shows a noncalcified solid mass (arrow) with an oval contour and predominantly circumscribed margins. **(b)** Craniocaudal (CC) image shows grouped round microcalcifications. **(c)** CC image shows a focal asymmetry (arrow) without associated calcifications or architectural distortion.

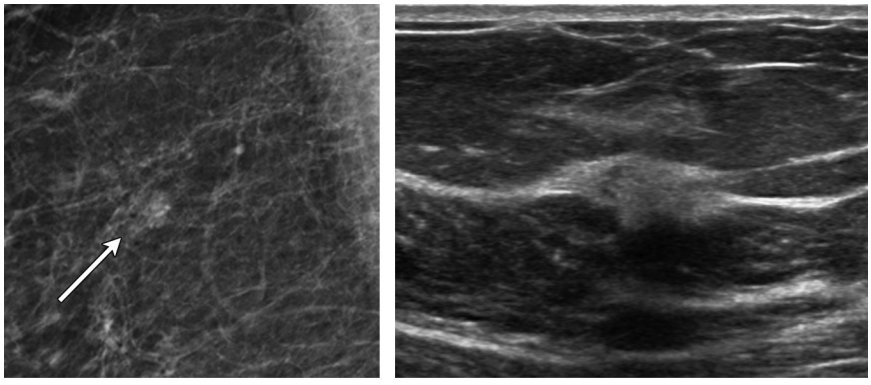


Figure 2. Suspected fat necrosis in a 58-year-old woman with a history of trauma. **(a)** MLO spot compression mammogram of the right breast shows a focal asymmetry (arrow). **(b)** Ultrasonographic (US) correlate image shows an echogenic parallel mass with irregular margins. Fat necrosis was suspected, and the lesion was classified as BI-RADS category 3. Follow-up mammography and US performed 6 months later showed no interval involution or improvement. The lesion was upgraded to BI-RADS category 4b. Biopsy revealed grade I invasive ductal carcinoma (IDC) and invasive lobular carcinoma. Fat necrosis should evolve to a more typical benign appearance over time (ie, increased fat and dystrophic calcification with decreased soft-tissue imaging characteristics).

take 8 or more weeks to resolve (13). In our clinical experience, hematomas often take more than 4 weeks to resolve, depending on their size. Thus, in our practice, we favor a slightly longer interval of 6–8 weeks (compared with 4 weeks per the BI-RADS fifth edition) for follow-up when a patient is suspected of having an involuting hematoma. If a stable or enlarging mass is seen at follow-up,

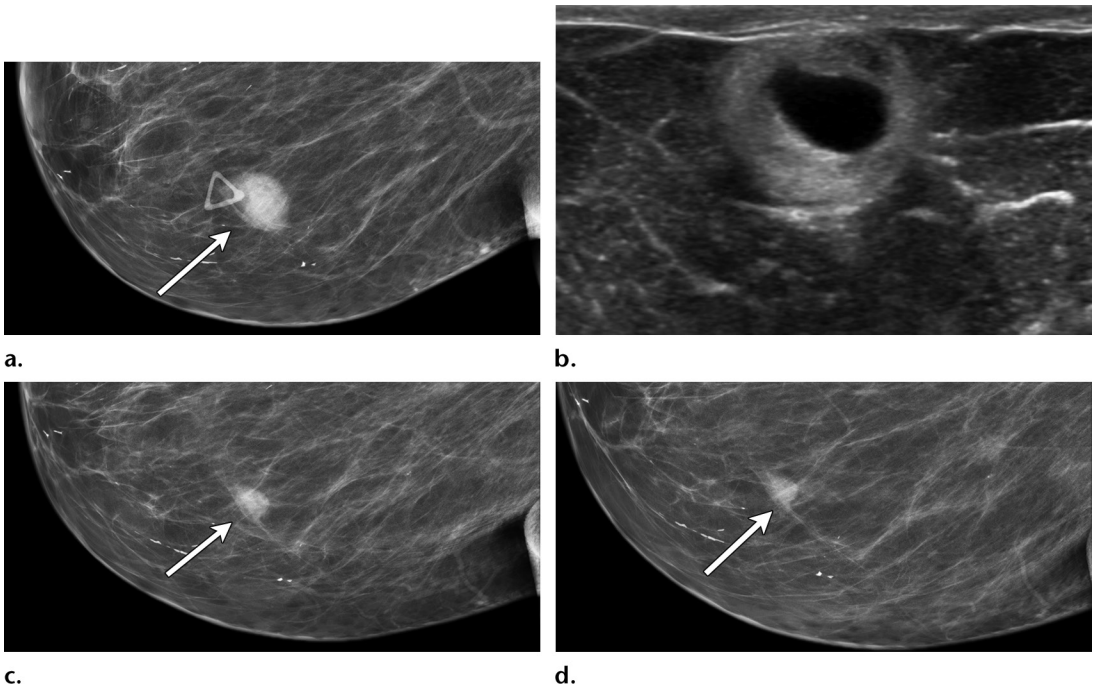
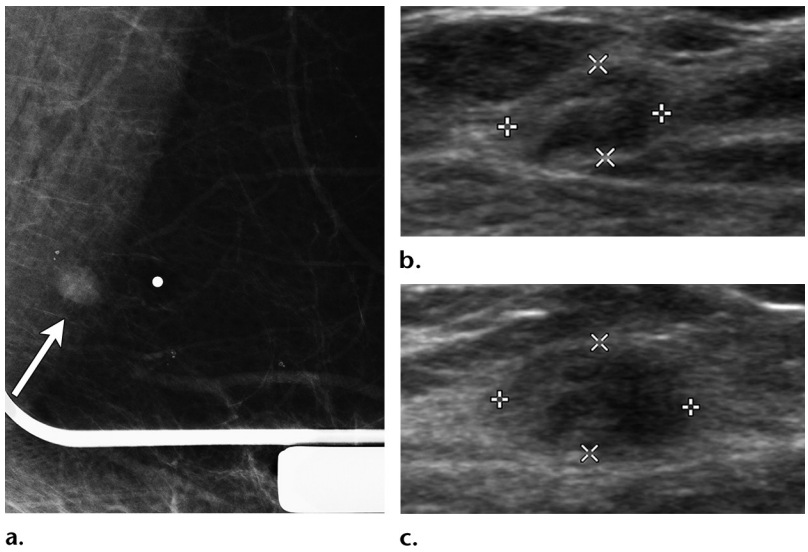


Figure 3. Suspected hematoma in a 67-year-old woman undergoing warfarin therapy. **(a)** MLO mammogram of the right breast shows a new circumscribed oval mass (arrow). **(b)** US image shows a hyperechoic round mass with a central anechoic region that corresponds to the mass seen in **a**. The clinical history and imaging appearance were indicative of a hematoma, and short-term 12-week follow-up was recommended. **(c, d)** MLO mammograms obtained at 12-week **(c)** and 24-week **(d)** follow-up show the mass (arrow) decreasing in size.

Figure 4. Enlarging deep posterior mass in a 57-year-old woman. **(a)** MLO spot compression mammogram of the left breast shows an oval well-circumscribed mass (arrow) in the axillary region. **(b)** US image of the mass shows an echogenic center. The lesion was thought to represent a low axillary lymph node and was classified as BI-RADS category 3. **(c)** US image obtained at 6-month follow-up shows a heterogeneous echotexture, and a follow-up mammogram (not shown) demonstrated interval enlargement. The lesion was upgraded, and biopsy revealed grade III IDC. As demonstrated in this patient, a complete diagnostic workup at follow-up surveillance must be performed to assess both stability and morphology. If either has changed, biopsy is warranted.



this finding should be considered suspicious, and biopsy should be performed.

Intramammary and low-lying axillary lymph nodes are common at mammography, and they sometimes change in size because of inflammatory, infectious, or even neoplastic processes. Lymph nodes are considered in the differential diagnosis when evaluating oval and circumscribed masses, particularly when they are located in the upper outer quadrant or when internal hyperechogenicity on targeted US images indicates a fatty hilum (Fig 4).

If a benign-appearing solid mass demonstrates growth, interval change trumps or supersedes benign morphology, and biopsy is warranted despite probably benign features (Fig 5). Mucinous, medullary, and papillary cancers and occasional invasive ductal cancers not otherwise specified may have features that overlap with those of benign masses, including oval or round shape and circumscribed margins (14). Sickles (3) showed that 11% (15 of 131) of all probably benign lesions with interval mammographic change were malignant at

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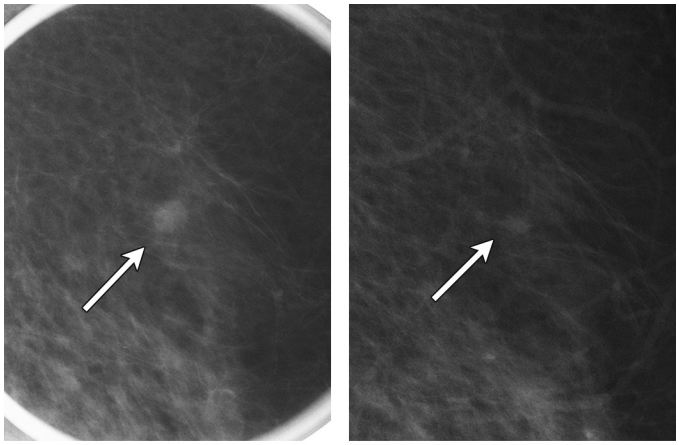


a. b.

Figure 5. Interval change in a benign-appearing mass in a 68-year-old woman. **(a)** MLO spot compression mammogram of the left breast shows a 5 × 6-mm solitary oval mass (arrow) with circumscribed margins. US findings were negative. **(b)** MLO screening mammogram obtained 1 year earlier shows that the original size of the mass (arrow) was 3 × 2 mm. Despite the interval change, the mass was incorrectly classified as BI-RADS category 3. At 6-month follow-up, a US correlate was identified, and the mass was upgraded to BI-RADS category 4. Biopsy revealed IDC. Mammographic growth of the mass in this patient is more important than its benign-appearing morphology, and it warranted initial classification as a BI-RADS category 4 lesion.

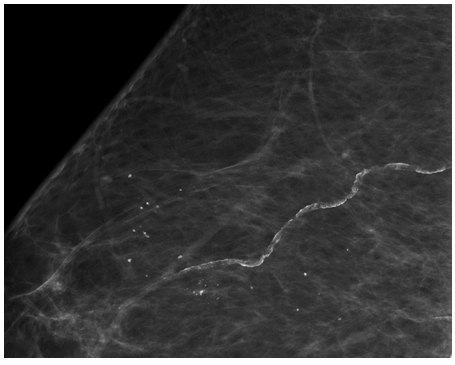


Figure 6. Calcifications in a 75-year-old woman with a recent seat belt injury. Mediolateral magnified mammogram of the right breast shows findings that were described in the radiology report as "new probable dystrophic, round calcifications in a regional distribution." These calcifications were not seen at a pretrauma imaging examination; therefore, a benign posttraumatic origin was suspected, a diagnosis of BI-RADS category 3 was made, and biopsy was avoided. The imaging findings have been stable for 35 months.

biopsy; 80% (12 of 15) of these lesions were well-circumscribed masses. Hermann et al (15) found that 55% of new masses and 48% of masses that increased in size were malignant. Likewise, Helvie et al (4) and Varas et al (6) showed that 10% (one of 10) and 56% (nine of 16), respectively, of probably benign lesions that showed progression during surveillance proved to be malignant. These figures are much higher than the widely accepted 2% or less positive predictive value for malignancy allowed for a probably benign lesion (1–3,6). Unless trauma or a reactive lymph node is suspected as a cause, a new or enlarging solid mass with benign imaging features should undergo biopsy.

Calcifications

Benign calcifications, such as vascular, milk of calcium, popcornlike, and dystrophic calcifications, have classically benign features. However, in their early stages, these calcifications may have morphologic features that overlap with malignancy and may, over time, show interval change. The patient's clinical history, including age, vascular disease, trauma, or previous biopsy, may help elucidate the cause of disease. Mediolateral and lateromedial views should be obtained in the workup for calcifications, as layering calcifications are diagnostic for benign milk of calcium calcifications. Vascular calcifications, which usually have a tram-track appearance, may have only one clearly visible wall and may be mistaken for fine linear calcifications suggestive of malignancy. Popcornlike calcifications suggestive of an involuting fibroadenoma or dystrophic calcifications after trauma or surgery may initially appear coarse and heterogeneous and may be of intermediate suspicion. Within the appropriate clinical (Fig 6) or imaging context (ie, developing calcifications potentially due to the same process as other clearly benign calcifications in the breast), short-term imaging follow-up may be a reasonable alternative to immediate biopsy. An interval increase in the number of calcifications that is not consistent with evolving benign causes or any development of more suspicious morphology (Fig 7) should prompt biopsy.

Focal Asymmetries

Focal asymmetries are two-view findings with concave margins and are usually interspersed with fat. They may be considered probably benign in the absence of findings that are suspicious for malignancy. Focal asymmetries that are new or that have shown an increase in size are termed *developing asymmetries*. When this finding is confirmed on diagnostic images, US is performed. If there is a US correlate, classification is made on the basis of correlation of

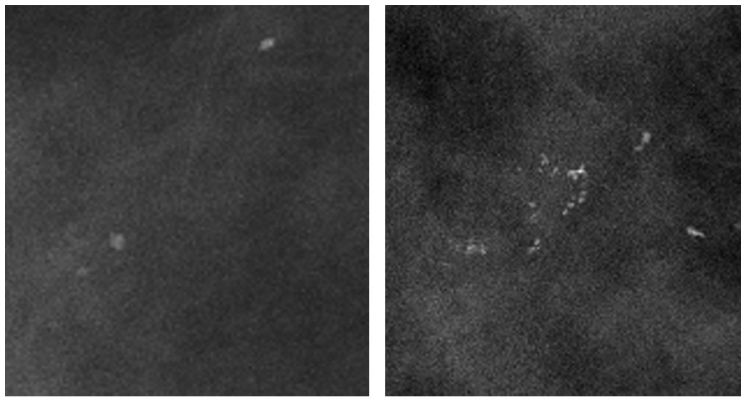


Figure 7. Developing calcifications in a 56-year-old woman. **(a)** Mediolateral magnified mammogram of the right breast shows a few round calcifications. These were classified as BI-RADS category 3 and were observed for 2 years without interval change. **(b)** Two-year follow-up mammogram shows new calcifications with fine pleomorphic morphology and grouped distribution, which were classified as BI-RADS category 4b. Ductal carcinoma in situ was revealed at biopsy. In this patient, grouped round calcifications were appropriately categorized as probably benign at the initial examination. Interval change in the number and morphology of calcifications is suspicious and warrants biopsy.

a. **b.**

the mammographic and US findings. Although infrequently reported during screening and diagnostic examinations, developing asymmetries have a relatively high positive predictive value for malignancy (16). When a developing asymmetry is seen at screening, 12.8% of these lesions will be malignant at biopsy; at diagnostic examination, 26.7% will be malignant (17,18). Developing asymmetries are associated with a sufficiently high probability of malignancy to warrant biopsy rather than short-term follow-up (18,19). Even when there is no US correlate, stereotactic biopsy should be pursued.

Challenging Clinical Scenarios

One-View Findings

Asymmetries, or one-view findings, are particularly challenging to evaluate (20). Asymmetries account for half of all unnecessary screening recalls and have the lowest positive predictive value of all types of findings (21). Likewise, a study by Venkatesen et al (16) showed that asymmetries seen at screening examinations are more weakly associated with cancer than are other types of lesions, accounting for 3.6% of invasive cancers and 13.3% of invasive cancers at diagnostic examinations, while comprising 20.5% of lesions at screening examinations. Asymmetries are frequently overcalled (false positive); however, they are also associated with a high number of false-negative assessments (22) (Fig 8). Several retrospective reviews show that 9%–38% of missed cancers first appeared as one-view asymmetries (23–26). Focused attention on asymmetries during residency training and in continuing medical education would be helpful, as asymmetries comprise a large set of miscalled lesions.

Postoperative Breast

The postoperative breast shows a considerable amount of change over time, especially within the first several years after treatment. Excisions of benign lesions usually result in typical planar (nonmasslike) architectural distortion due to scarring, and they can sometimes result in fat necrosis–type calcifications. After lumpectomy and radiation therapy, calcifications, planar architectural distortion, and masses are several types of findings that are commonly seen and may mimic recurrence. It can be a challenge to differentiate early benign evolutional changes from recurrent malignancy, as neither is an uncommon finding (Figs 9–11). Recurrence rates after breast conservation therapy have been reported as 7% at 5 years and 14% at 10 years (27). Benign calcifications related to breast conservation therapy have a reported incidence of 28% within the first 6–12 months after therapy (27). Despite an overlap in imaging appearance, differences in temporal and morphologic appearances may help with evaluation. Mammographic stability, or lack of interval change between studies, is typically achieved 2–3 years after treatment (27,28). This is the same time at which local breast recurrences begin to appear.

After posttreatment changes have stabilized, any new changes should be scrutinized carefully and should be considered potentially suspicious for recurrence. Most posttreatment masses diminish over time and evolve into scars (27). Benign calcifications that may develop include dystrophic calcifications, thin-rimmed calcifications surrounding a radiolucent oil cyst, smooth round calcifications, and needlelike calcifications (27). Benign calcifications tend to develop earlier than malignant calcifications and usually have a different morphology. However, some developing calcifications at the lumpectomy bed may be problematic, and they require imaging surveillance or biopsy if they are suspicious. In an analysis of benign and malignant calcifications at the lumpectomy bed, it was reported that most new calcifications at the lumpectomy bed that were initially assessed as probably

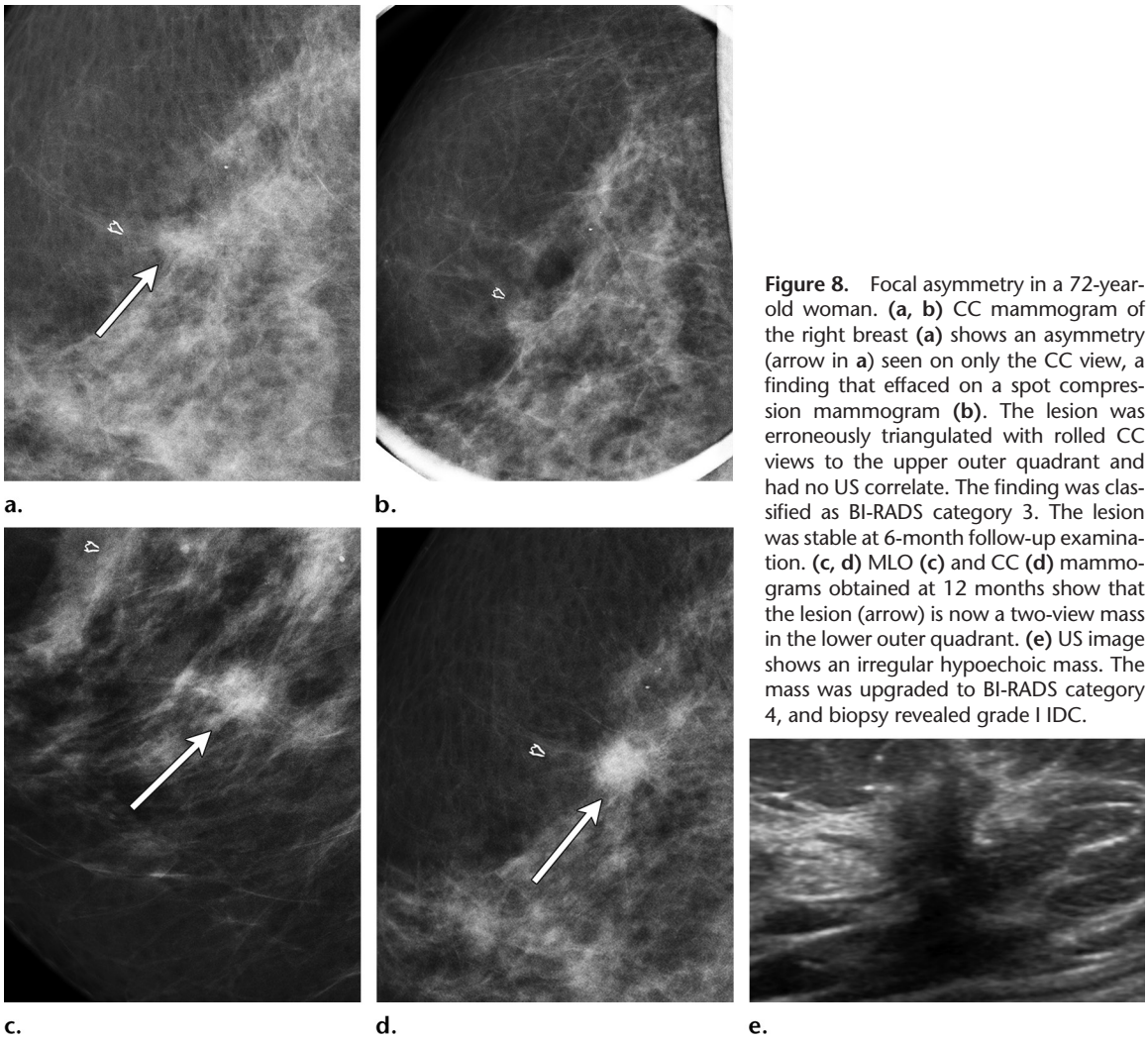


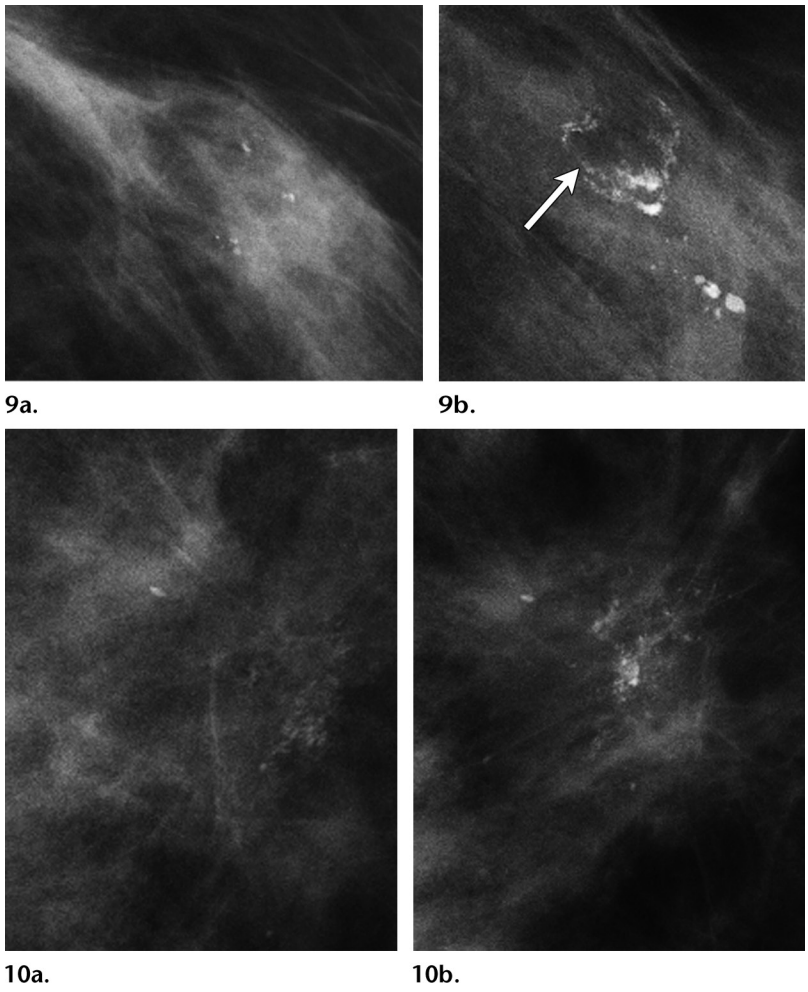
Figure 8. Focal asymmetry in a 72-year-old woman. **(a, b)** CC mammogram of the right breast **(a)** shows an asymmetry (arrow in **a**) seen on only the CC view, a finding that effaced on a spot compression mammogram **(b)**. The lesion was erroneously triangulated with rolled CC views to the upper outer quadrant and had no US correlate. The finding was classified as BI-RADS category 3. The lesion was stable at 6-month follow-up examination. **(c, d)** MLO **(c)** and CC **(d)** mammograms obtained at 12 months show that the lesion (arrow) is now a two-view mass in the lower outer quadrant. **(e)** US image shows an irregular hypoechoic mass. The mass was upgraded to BI-RADS category 4, and biopsy revealed grade I IDC.

benign and placed into imaging surveillance evolved quickly (6–12 months) to more benign or more suspicious morphology (29). Architectural distortion secondary to posttreatment changes may appear as a spiculated, poorly marginated, dense area with interspersed fat, lack of a central mass, and central radiolucency. Findings suggestive of tumor recurrence include a central mass, fine straight spiculations, skin retraction, and an increase in nodularity (27).

Quality Control and Technical Parameters

Technical differences between examinations can make it difficult to assess stability. Studies performed with different reconstruction algorithms or conversion of analog studies to digital studies may make comparison difficult in the assessment of microcalcifications (Fig 12). Motion blur may also obscure the morphology of calcifications and lesion margins (30). Rosen et al (31) found that motion blur compromised image quality of 62% of cancers that manifested as microcalcifications and were incorrectly assessed as BI-RADS category 3 lesions. Comparison should be made by using mammographic views similar to those used in the previous study (2,31). If spot compression views were not used in prior studies, the assessment of stability should include comparison of images obtained in standard views.

Patient anatomy may also lead to difficult positioning and difficulty in replicating standard views from year to year. Deep posterior lesions may pose such challenges, and suboptimal positioning can decrease the rate of cancer detection (32). Bird et al (25) found that one-third of missed lesions were located in the retroglandular tissue. If a lesion seen on the current study was not visible on prior studies because the area was not included on prior images, stability cannot be assessed (2). Another scenario that interferes with positioning, year-to-year comparison, and interpretation of mammograms is the presence of breast implants (33,34) (Fig 13). Screening mammography of an augmented breast with use of both implant-included and implant-displaced



Figures 9, 10. **(9)** Dystrophic calcifications in the left breast in a 52-year-old woman after breast reduction mammoplasty. **(a)** CC magnified mammogram obtained 6 months after surgery shows lesions that were classified as BI-RADS category 3 for suspicion of fat necrosis. **(b)** CC magnified mammogram obtained 6 months after **a** shows increased dystrophic calcifications (arrow) typical of evolving fat necrosis. Despite an increase in the number of calcifications, the dystrophic morphology suggested benignity. The patient has been without evidence of disease for 28 months. **(10)** Developing calcifications in the right breast in a 55-year-old woman 2 years after lumpectomy and radiation therapy. **(a)** CC magnified mammogram of the right breast shows new coarse questionable dystrophic calcifications. The lesions were classified as BI-RADS category 3. **(b)** CC magnified mammogram obtained at 6-month follow-up shows that the calcifications have increased in number in a segmental distribution. The morphology appears amorphous, coarse, and heterogeneous. The calcifications were upgraded to BI-RADS category 4a, and biopsy revealed recurrent IDC. Developing calcifications near a postbiopsy or postlumpectomy site must be scrutinized for morphology and distribution. Dystrophic calcifications are expected and may be closely observed. Development into suspicious morphology during surveillance warrants biopsy.

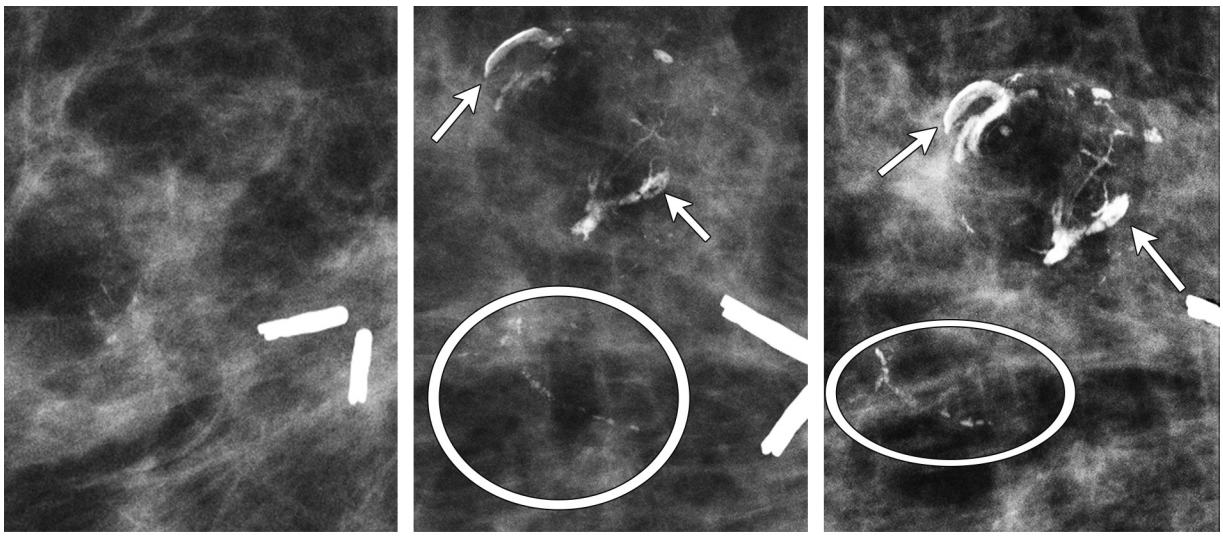


Figure 11. Developing calcifications in a 42-year-old woman 30 months after lumpectomy and radiation therapy. **(a)** MLO mammogram of the right breast obtained 6 months after treatment shows few dystrophic calcifications in the lumpectomy bed. **(b)** Mediolateral mammogram of the right breast obtained 1 year after treatment shows dystrophic calcifications around an area of lucency (arrows), as well as new curvilinear calcifications (circled). The findings were thought to be consistent with evolving fat necrosis and were classified as BI-RADS category 3. **(c)** Mediolateral mammogram obtained at 6-month follow-up shows increased prominence of the dystrophic calcifications (arrows). The calcifications, which were initially thought to be curvilinear, have grown and have developed a suspicious linear or branching morphology (within oval). The lesion was upgraded to BI-RADS category 4b, and biopsy revealed grade III IDC. Developing calcifications near a postbiopsy or postlumpectomy site must be scrutinized for morphology and distribution. Dystrophic calcifications are expected and may be followed closely, as they may have a more indeterminate appearance initially. Development into suspicious morphology and distribution warrants biopsy.

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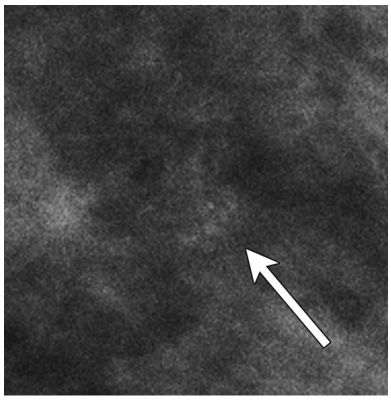
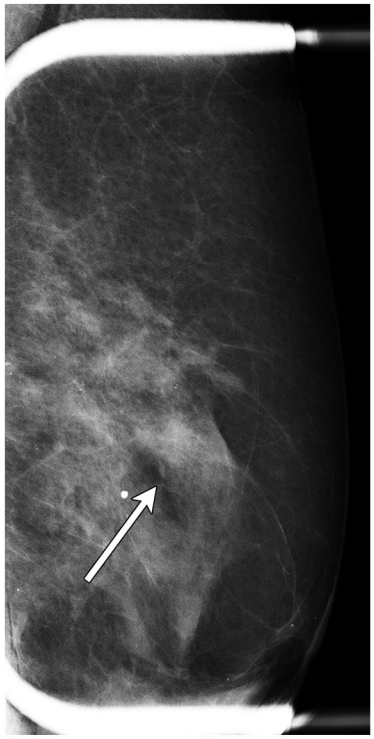


12a.

Figures 12, 13. **(12)** Calcifications of questionable stability in a 58-year-old woman. **(a)** CC magnified mammogram shows amorphous calcifications (arrow) that layered on mediolateral mammograms (not shown). Although these lesions were thought to be probable milk of calcium calcifications, they were not definitely seen at a prior examination and were classified as BI-RADS category 3. **(b)** CC mammogram obtained at the prior examination, where a smoothing postprocessing algorithm was applied that precluded the radiologist from commenting on stability. **(13)** Calcifications in a 59-year-old woman with a subglandular silicone gel breast implant. **(a)** MLO implant-displaced mammogram of the left breast shows a focal asymmetry (arrow) without other suspicious features. No US correlate was seen, and the lesion was classified as BI-RADS category 3. **(b)** On an MLO implant-displaced mammogram obtained at 6-month follow-up, new punctate scattered calcifications superimposed on the focal asymmetry were missed. **(c)** MLO implant-displaced mammogram obtained at 12-month follow-up shows increased segmental, coarse, heterogeneous, fine pleomorphic calcifications in the same region. The lesion was upgraded to BI-RADS category 4c and was found to be IDC grade I. A posterior lesion location in a patient with breast implants makes positioning challenging.

12b.



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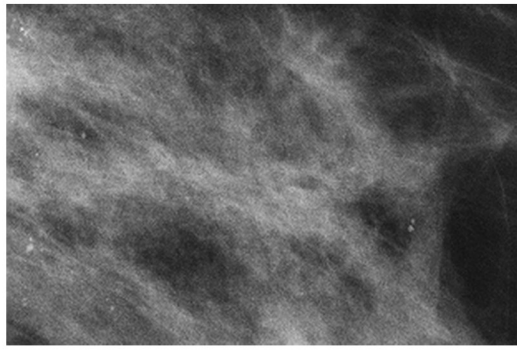
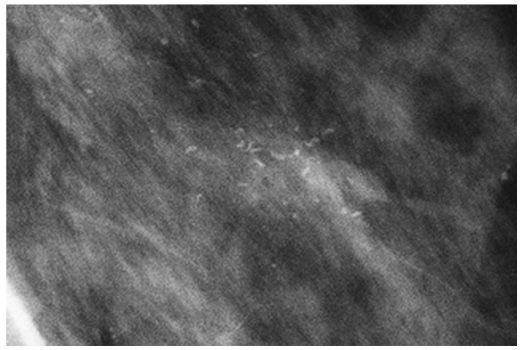


13b.



13c.

views has a 45% sensitivity for detection of cancer, compared with a 67% sensitivity in the nonaugmented breast (35).

Errors in Management and Assessment

Screening mammograms alone are not sufficient to enable classification of a BI-RADS category 3 lesion (Fig 14). In the BI-RADS fifth edition, one of the modifications explicitly states that the term *probably benign* should not be used at screening mammography; it should be used only after imaging workup of screening-detected findings (1). Common reasons for incomplete assessment include lack of US images (Fig 15) or lack of spot compression images for masses or focal asymmetries, calcifications not evaluated with magnification images, and acceptance of images for interpretation despite technical inadequacy. Sickles (3) argued that further mammographic and US images may be used to *(a)* identify definitively benign lesions, such as cysts or benign calcifications, with more confidence and *(b)* identify more malignant features of a lesion that were not apparent on screening images. This may lead to fewer lesions being placed into short-term follow-up and, consequently, to more definitive management (2,3,36,37). Furthermore, a diagnostic baseline examination may be performed and the results used for comparison with follow-up examination results (2).

Negative US findings may mislead a radiologist into placing a suspicious mammographic finding into the probably benign category (Figs 4, 14). However, even if the US findings are normal, the technique depicting the most suspicious-looking

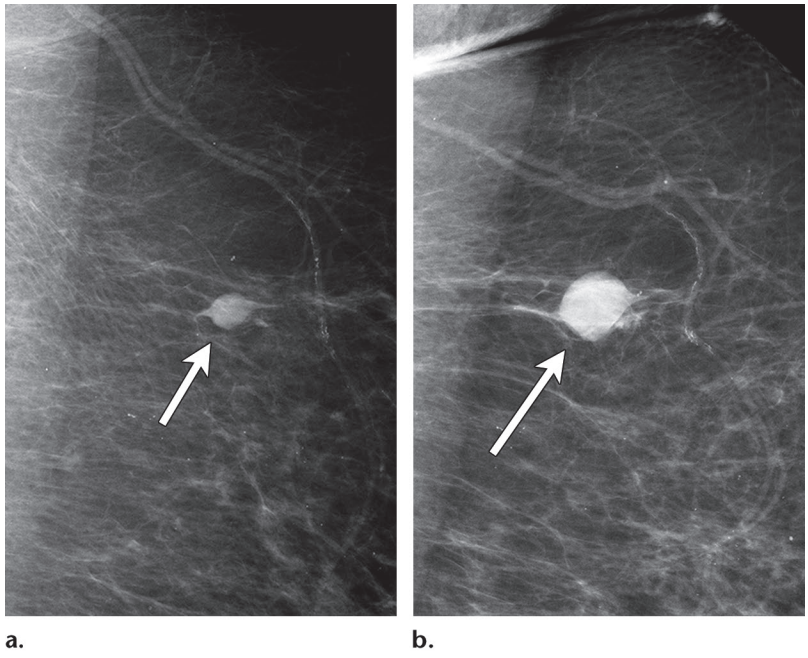


Figure 14. Mass found at screening mammography in a 73-year-old woman. **(a)** MLO screening mammogram of the left breast shows a small circumscribed mass (arrow) that was classified as a BI-RADS category 3 lesion without further diagnostic mammography and with negative findings at US. **(b)** MLO mammogram obtained at 6-month follow-up shows an increase in mass size and density (arrow). **(c)** Color Doppler US image shows a round isoechoic mass with vascular flow. The finding was suspicious, and the lesion was upgraded to BI-RADS category 5. Biopsy revealed mucinous papillary carcinoma. Eventual pathologic analysis after a lumpectomy revealed grade III node-negative mucinous ductal carcinoma. A full diagnostic workup that includes spot compression, magnification, and additional views, when appropriate, and US must be performed before classifying any lesion as BI-RADS category 3.

image should be used to make the final assessment (38–40). A suspicious mammographic lesion should not be downgraded to the probably benign category on the basis of negative US findings. Likewise, a lesion that appears to be probably benign at mammography and has suspicious US features should undergo biopsy, with the possible exception of fat necrosis.

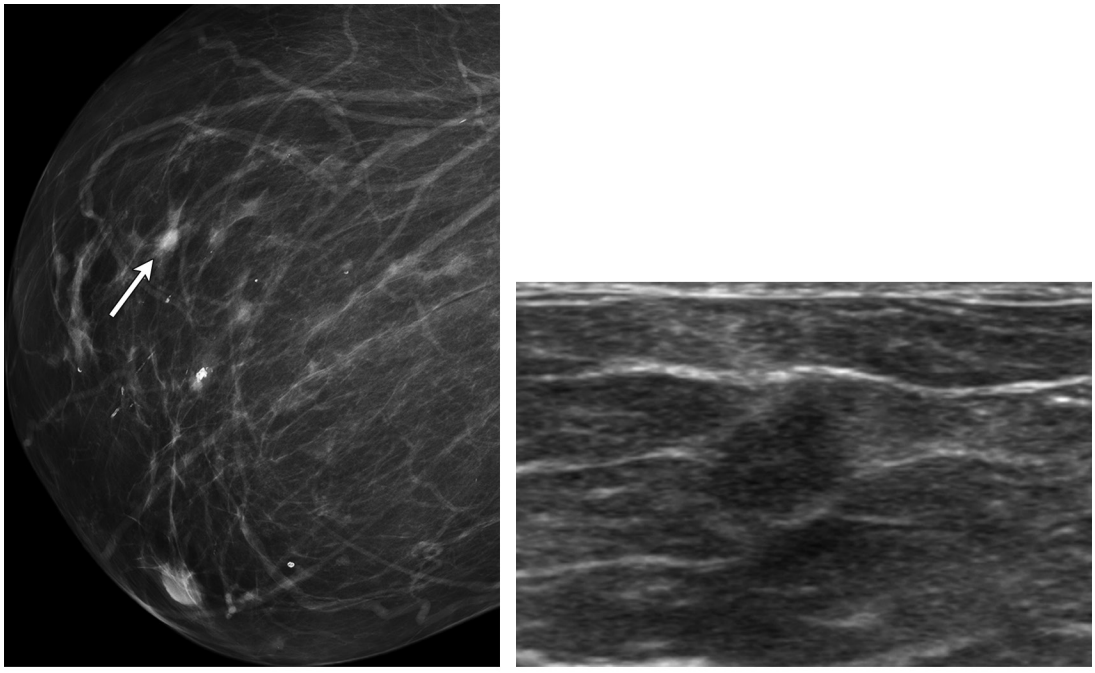
Incomplete BI-RADS description of findings may lead to inappropriate assessment (Fig 16). Several studies have shown that in practice, a minority of BI-RADS category 3 lesions actually meet the morphologic criteria to be considered probably benign lesions according to the BI-RADS lexicon. A study by Lehman et al (7) showed that only 20% of BI-RADS category 3 lesions met the criteria to be considered probably benign. Rosen et al (31) retrospectively reviewed 51 lesions that initially had been assessed as probably benign and later were diagnosed as malignant. None of the 51 lesions met the strict morphologic criteria for probably benign lesions at the time of the original recommendation for short-interval follow-up. Understanding the implications behind each of the BI-RADS descriptors and undergoing extensive training to distinguish each type of lesion could help decrease the rate of misclassified lesions.

Interobserver Variability

Disagreement in the use of BI-RADS descriptors from one examination to the next may lead to an upgrade in BI-RADS categorization without any demonstrable change between examinations. Onega et al (21) showed that differences in agreement were often the result of varying nomenclature given to the lesion. Adherence to proper use of BI-RADS descriptors and complete lesion description, including both morphology and distribution, may help decrease interobserver variability (41,42).

Conclusion

BI-RADS category 3 lesions should be carefully scrutinized during follow-up, as many of these lesions represent diagnostically challenging cases. An initial assessment of probable benignity should not bias the subsequent radiologist's assessment; a complete diagnostic evaluation and an objective approach are critical in these evaluations. The radiologist performing the follow-up diagnostic evaluation for a lesion previously assessed as BI-RADS category 3 should objectively determine whether the lesion truly merits a probably benign categorization. Although the original definition of a BI-RADS category 3 lesion assumed there was no prior image for comparison, in clinical practice, many lesions with available prior images are placed into BI-RADS category 3. In the correct clinical context, this practice can avert many unnecessary biop-



a. b.

Figure 15. Enlarging mass in a 73-year-old woman who was recalled for diagnostic evaluation. **(a)** MLO mammogram of the right breast shows a small, oval, well-circumscribed mass (arrow) in the region of other neighboring small masses. The stability of the mass was difficult to confirm because of the patient's large breast and confounding lesions. The mass was assessed as an intramammary lymph node and was classified as BI-RADS category 3 without US evaluation. After 6 months, the mass had enlarged on mammograms (not shown). **(b)** US image obtained at 6-month follow-up shows an indistinct, irregular, hypoechoic mass. The mass was upgraded to BI-RADS category 4c, and biopsy revealed grade II IDC. No positive lymph nodes were discovered at resection.

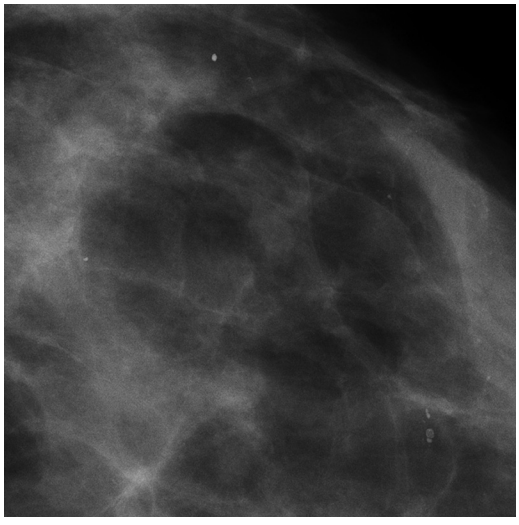


Figure 16. Misclassified calcifications in a 42-year-old woman. CC magnified mammogram of the left breast shows calcifications that were described as "coarse and amorphous" on the radiology report. The lesions were classified as BI-RADS category 3. Findings were similar in the contralateral breast. The original report did not assess distribution. At retrospective review, the calcifications appear more lucent-centered, round, and scattered. The findings are in keeping with BI-RADS category 2. Both incorrect morphologic interpretation and no description of the distribution pattern may lead to inappropriate assessment.

sies when probably benign causes are suspected. Although interval change is an important feature of malignancy, many benign lesions also change over time. Imaging change may be balanced against morphology, clinical history, and clinical experience in lesion assessment and management.

References

1. D'Orsi CJ, Sickles EA, Mendelson EB, et al. Breast Imaging Reporting and Data System: ACR BI-RADS breast imaging atlas. 5th edition. Reston, Va: American College of Radiology, 2013.
2. Leung JW, Sickles EA. The probably benign assessment. Radiol Clin North Am 2007;45(5):773–789, vi.
3. Sickles EA. Periodic mammographic follow-up of probably benign lesions: results in 3184 consecutive cases. Radiology 1991;179(2):463–468.
4. Helvie MA, Pennes DR, Rebner M, Adler DD. Mammographic follow-up of low-suspicion lesions: compliance rate and diagnostic yield. Radiology 1991;178(1):155–158.
5. Vizcaíno I, Gadea L, Andreo L, et al. Short-term follow-up results in 795 nonpalpable probably benign lesions detected at screening mammography. Radiology 2001;219(2):475–483.
6. Varas X, Leborgne F, Leborgne JH. Nonpalpable, probably benign lesions: role of follow-up mammography. Radiology 1992;184(2):409–414.
7. Lehman CD, Rutter CM, Eby PR, White E, Buist DS, Taplin SH. Lesion and patient characteristics associated with malignancy after a probably benign finding on community practice mammography. AJR Am J Roentgenol 2008;190(2):511–515.
8. Chung CS, Giess CS, Gombos EC, et al. Patient compliance and diagnostic yield of 18-month unilateral follow-up

in surveillance of probably benign mammographic lesions. AJR Am J Roentgenol 2014;202(4):922–927.
9. Taboada JL, Stephens TW, Krishnamurthy S, Brandt KR, Whitman GJ. The many faces of fat necrosis in the breast. AJR Am J Roentgenol 2009;192(3):815–825.
10. Hogge JP, Robinson RE, Magnant CM, Zuurbier RA. The mammographic spectrum of fat necrosis of the breast. RadioGraphics 1995;15(6):1347–1356.
11. Stigers KB, King JG, Davey DD, Stelling CB. Abnormalities of the breast caused by biopsy: spectrum of mammographic findings. AJR Am J Roentgenol 1991;156(2):287–291.
12. Raza S, Goldkamp AL, Chikarmane SA, Birdwell RL. US of breast masses categorized as BI-RADS 3, 4, and 5: pictorial review of factors influencing clinical management. RadioGraphics 2010;30(5):1199–1213.
13. Peters ME, Fagerholm MI, Scanlan KA, Voegeli DR, Kelcz F. Mammographic evaluation of the postsurgical and irradiated breast. RadioGraphics 1988;8(5):873–899.
14. Meyer JE, Amin E, Lindfors KK, Lipman JC, Stomper PC, Genest D. Medullary carcinoma of the breast: mammographic and US appearance. Radiology 1989;170(1 Pt 1):79–82.
15. Hermann G, Keller RJ, Tartter P, Bleiweiss I, Rabinowitz JG. Interval changes in nonpalpable breast lesions as an indication of malignancy. Can Assoc Radiol J 1995;46(2):105–110.
16. Venkatesan A, Chu P, Kerlikowske K, Sickles EA, Smith-Bindman R. Positive predictive value of specific mammographic findings according to reader and patient variables. Radiology 2009;250(3):648–657.
17. Leung JW, Sickles EA. Developing asymmetry identified on mammography: correlation with imaging outcome and pathologic findings. AJR Am J Roentgenol 2007;188(3): 667–675.
18. Price ER, Joe BN, Sickles EA. The developing asymmetry: revisiting a perceptual and diagnostic challenge. Radiology 2015;274(3):642–651.
19. Chesebro AL, Winkler NS, Birdwell RL, Giess CS. Developing asymmetries at mammography: a multimodality approach to assessment and management. RadioGraphics 2016;36(2):322–334.
20. Giess CS, Frost EP, Birdwell RL. Interpreting one-view mammographic findings: minimizing callbacks while maximizing cancer detection. RadioGraphics 2014;34(4):928–940.
21. Onega T, Smith M, Miglioretti DL, et al. Radiologist agreement for mammographic recall by case difficulty and finding type. J Am Coll Radiol 2012;9(11):788–794.
22. Ciatto S, Houssami N, Ambrogetti D, Bonardi R, Collini G, Del Turco MR. Minority report: false negative breast assessment in women recalled for suspicious screening mammography—imaging and pathological features, and associated delay in diagnosis. Breast Cancer Res Treat 2007;105(1):37–43.
23. Ikeda DM, Andersson I, Wattsgård C, Janzon L, Linell F. Interval carcinomas in the Malmö Mammographic Screening Trial: radiographic appearance and prognostic considerations. AJR Am J Roentgenol 1992;159(2):287–294.
24. Goergen SK, Evans J, Cohen GP, MacMillan JH. Characteristics of breast carcinomas missed by screening radiologists. Radiology 1997;204(1):131–135.
25. Bird RE, Wallace TW, Yankaskas BC. Analysis of cancers missed at screening mammography. Radiology 1992;184(3): 613–617.
26. Saarenmaa I, Salminen T, Geiger U, et al. The visibility of cancer on previous mammograms in retrospective review. Clin Radiol 2001;56(1):40–43.
27. Krishnamurthy R, Whitman GJ, Stelling CB, Kushwaha AC. Mammographic findings after breast conservation therapy. RadioGraphics 1999;19(Spec No):S53–S62; quiz S262–S263.
28. Neal CH, Yilmaz ZN, Noroozian M, et al. Imaging of breast cancer–related changes after surgical therapy. AJR Am J Roentgenol 2014;202(2):262–272.
29. Giess CS, Keating DM, Osborne MP, Mester J, Rosenblatt R. Comparison of rate of development and rate of change for benign and malignant breast calcifications at the lumpectomy bed. AJR Am J Roentgenol 2000;175(3):789–793.
30. Majid AS, de Paredes ES, Doherty RD, Sharma NR, Salvador X. Missed breast carcinoma: pitfalls and pearls. RadioGraphics 2003;23(4):881–895.
31. Rosen EL, Baker JA, Soo MS. Malignant lesions initially subjected to short-term mammographic follow-up. Radiology 2002;223(1):221–228.
32. Giess CS, Frost EP, Birdwell RL. Difficulties and errors in diagnosis of breast neoplasms. Semin Ultrasound CT MR 2012;33(4):288–299.
33. Margolis NE, Morley C, Lotfi P, et al. Update on imaging of the postsurgical breast. RadioGraphics 2014;34(3): 642–660.
34. Tuli R, Flynn RA, Brill KL, Sabol JL, Usuki KY, Rosenberg AL. Diagnosis, treatment, and management of breast cancer in previously augmented women. Breast J 2006;12(4): 343–348.
35. Miglioretti DL, Rutter CM, Geller BM, et al. Effect of breast augmentation on the accuracy of mammography and cancer characteristics. JAMA 2004;291(4):442–450.
36. Sickles EA. Management of probably benign breast lesions. Radiol Clin North Am 1995;33(6):1123–1130.
37. Sickles EA. Probably benign breast lesions: when should follow-up be recommended and what is the optimal follow-up protocol? Radiology 1999;213(1):11–14.
38. Boyer B, Canale S, Arfi-Rouche J, Monzani Q, Khaled W, Balleyguier C. Variability and errors when applying the BIRADS mammography classification. Eur J Radiol 2013;82(3):388–397.
39. Yasmeen S, Romano PS, Pettinger M, et al. Frequency and predictive value of a mammographic recommendation for short-interval follow-up. J Natl Cancer Inst 2003;95(6): 429–436.
40. Bennett ML, Welman CJ, Celliers LM. How reassuring is a normal breast ultrasound in assessment of a screen-detected mammographic abnormality? A review of interval cancers after assessment that included ultrasound evaluation. Clin Radiol 2011;66(10):928–939.
41. Antonio AL, Crespi CM. Predictors of interobserver agreement in breast imaging using the Breast Imaging Reporting and Data System. Breast Cancer Res Treat 2010;120(3): 539–546.
42. Bent CK, Bassett LW, D'Orsi CJ, Sayre JW. The positive predictive value of BI-RADS microcalcification descriptors and final assessment categories. AJR Am J Roentgenol 2010;194(5):1378–1383.