

A Pictorial Review of Changes in the BI-RADS Fifth Edition¹

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Abbreviations: ACR = American College of Radiology, BI-RADS = Breast Imaging Reporting and Data System

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SA-CME LEARNING OBJECTIVES

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

- Describe suspicious mammographic findings with use of BI-RADS terminology.
- Identify new US descriptors used in the BI-RADS lexicon.
- Discuss appropriate use of the BI-RADS lexicon in breast MR imaging.

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Initially developed in 1993, the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) lexicon serves to standardize breast imaging reports, improve communication with referring physicians, and provide a quality assurance tool. The long-awaited BI-RADS fifth edition consolidates, improves, and expands the lexicon for mammography, breast ultrasonography (US), and breast magnetic resonance (MR) imaging. The new edition has increased the number of imaging examples to nearly 600. The breast MR imaging lexicon is significantly expanded since it first appeared in the fourth edition. New terms have been added to the US lexicon to reflect technologic advances. Minor but important changes have been made to the mammography section. Calcification descriptors in the lexicon are now consolidated into two categories: benign and suspicious. The controversial “intermediate concern” grouping has been eliminated, and a table in the lexicon summarizes the literature supporting the recommendation to biopsy such calcifications. New descriptors such as “developing asymmetry” are illustrated, and abstracts are provided to reference their significance. A generous guidance section is included after the lexicon description for each modality. Useful frequently asked questions are succinctly answered, and the literature to support each answer is included in the reference section for each modality. This review article illustrates and highlights changes to the BI-RADS lexicon and provides readers with a general overview to familiarize them with the fifth edition.

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Introduction

Use of standardized terminology, report organization, and assessment structures allows radiologists to communicate breast imaging findings to referring physicians clearly and succinctly. The much-anticipated fifth edition of the American College of Radiology (ACR) Breast Imaging Reporting and Data System (BI-RADS) lexicon was released in February 2014 (1). Because the previous edition was used in clinical practice for more than 10 years, radiologists may have difficulty learning the specific changes included in the fifth edition. The majority of changes represent reorganization and consolidation of terms, but there are also new descriptors in the lexicon. This article reviews and illustrates the changes in the BI-RADS fifth edition. A brief history of the BI-RADS lexicon is presented, followed by a detailed description of updates to the mammography, ultrasonography (US), and magnetic resonance (MR) imaging sections of the lexicon.

Brief History of BI-RADS

Before the development of the BI-RADS lexicon, mammography reports contained ambiguous and often unintelligible descriptions that made clinical management difficult for referring physicians. The first edition of the BI-RADS lexicon was released by the ACR

TEACHING POINTS

- Calcifications with suspicious morphology have an increased risk for malignancy, with a probability of 13% in coarse heterogeneous, 27% in amorphous, 50% in fine pleomorphic, and 78% in fine linear or fine linear branching calcifications.
- A developing asymmetry is a focal asymmetry that is new or more conspicuous over time.
- Four new terms have been added to the US "special cases" category: *simple cyst*, *vascular abnormalities* (with the additional terms *arteriovenous malformations* and *Mondor disease*), *postsurgical fluid collection*, and *fat necrosis*.
- The fifth edition of the MR imaging lexicon adds descriptors for the amount of fibroglandular tissue and background parenchymal enhancement.
- The new BI-RADS MR imaging lexicon contains descriptors to standardize findings related to silicone breast implants.

in 1993, with the goal of standardizing mammography reporting by providing a specific lexicon of imaging features. Lexicon descriptors were designed to predict both benign and malignant disease, eliminate ambiguity, allow automated data collection, and facilitate communication with referring physicians. Structured reports were organized into several categories, including breast density, description of findings, and a final decision-oriented assessment. Revisions were made in 1995, 1998 (the addition of an imaging atlas with examples of each descriptor), 2003 (revised terminology, subdivided category 4 findings, and introduction of US and MR imaging standardization), and 2014. Use of the BI-RADS lexicon now facilitates quality assurance, communication, research, and improved care. The success of the BI-RADS lexicon has been so noted that the basic concept of cataloging, describing, and reporting important disease processes is being replicated in other areas of imaging. The following quality assurance tools are now available: liver (LI-RADS), head injury (HI-RADS), lung cancer screening (lung-RADS), and prostate cancer (PI-RADS) lexicons.

Overview of BI-RADS Fifth Edition: Mammography Revisions

The mammography lexicon has changed from the previous edition by eliminating and/or consolidating terminology, with a few new additions. The complete list of changes is described in Figure 1.

Density

In the fourth edition, breast density was characterized on the basis of the percentile of glandular tissue within each breast (<25%, 25%–50%, 51%–75%, or >75%). Breast density characterization in the

new edition is purely subjective, with elimination of the percentiles (Fig 6). The fifth edition reverts to the original description of breast density that was used in the first few editions. The four category descriptors are phrased the same in the fourth and fifth editions: almost entirely fatty, scattered areas of fibroglandular density, heterogeneously dense, and extremely dense.

Masses

Mass shapes are reduced to three categories in the fifth edition: oval, round, and irregular (Fig 2). The term *lobular* has been eliminated and absorbed into the term *round* or *oval* or, if there are more than two to three gentle lobulations, the term *irregular*.

Margin categorization is unchanged, with five categories described: circumscribed, obscured, microlobulated, indistinct, and spiculated. In general, these descriptors are arranged from least suspicious to most suggestive of malignancy.

The terminology for density of masses is mostly unchanged, with four categories described: high density, equal density, low density, and fat containing. The term *radiolucent* has been eliminated from the fourth category.

Calcifications

In the fourth edition, calcifications were separated into three categories: typically benign, intermediate concern, and higher probability. They are now consolidated into two categories: typically benign and suspicious morphology. In the "typically benign" category, eggshell and lucent-centered calcifications have been combined into a new term, *rim*, while round and punctate calcifications are combined into the term *round* (Fig 3).

Amorphous, coarse heterogeneous, fine pleomorphic, and fine linear or fine linear branching calcifications are now placed in the "suspicious morphology" category (Fig 4). The term *indistinct calcification* has been eliminated. These changes reflect the fact that calcifications with suspicious morphology have an increased risk for malignancy, with a probability of 13% in coarse heterogeneous, 27% in amorphous, 50% in fine pleomorphic, and 78% in fine linear or fine linear branching calcifications (2).

Distribution of calcifications has been simplified in the fifth edition by eliminating the terms *scattered* and *clustered*. The five remaining distributions are termed *diffuse*, *segmental*, *regional*, *grouped*, and *linear*. The number of calcifications in the "grouped" distribution has been revised to include (a) a minimum of five calcifications within 1 cm of each other and (b) a larger number of calcifications within 2 cm of each other.

Fourth Edition	Fifth Edition	Changes
A. Masses	A. Masses	
1. Shape	1. Shape (Fig 2)	Reordered "oval" and "round"
a. Round	a. Oval	Omitted "lobular"
b. Oval	b. Round	
c. Lobular	c. Irregular	
d. Irregular		
2. Margin	2. Margin	Reordered "microlobulated" and "obscured"
a. Circumscribed	a. Circumscribed	
b. Microlobulated	b. Obscured	
c. Obscured	c. Microlobulated	
d. Indistinct	d. Indistinct	
e. Spiculated	e. Spiculated	
3. Density	3. Density	Omitted "radiolucent"
a. High density	a. High density	
b. Equal density	b. Equal density	
c. Low density	c. Low density	
d. Fat-containing radiolucent	d. Fat-containing	
B. Calcifications	B. Calcifications	
1. Typically benign	1. Typically benign	Combined "eggshell" and "lucent-centered" into "rim"; combined "punctate" and "round" into "round" (Fig 3)
a. Skin calcifications	a. Skin	Reordered "dystrophic," "milk of calcium," and "suture"
b. Vascular calcifications	b. Vascular	
c. Coarse or "popcorn-like" calcifications	c. Coarse or "popcorn-like"	
d. Large rod-like calcifications	d. Large rod-like	
e. Round calcifications	e. Round	
f. Lucent-centered calcifications	f. Rim	
g. Eggshell or rim calcifications	g. Dystrophic	
h. Milk of calcium calcifications	h. Milk of calcium	
i. Suture calcifications	i. Suture	
j. Dystrophic calcifications		
2. Intermediate concern, suspicious calcifications	2. Suspicious morphology (Fig 4)	Combined "intermediate concern, suspicious calcifications" and "higher probability malignancy"
a. Amorphous or indistinct calcifications	a. Amorphous	Omitted "indistinct"
b. Coarse heterogeneous calcifications	b. Coarse heterogeneous	Added "fine pleomorphic"
3. Higher probability malignancy	c. Fine pleomorphic	Added "fine linear or fine linear branching"
a. Fine pleomorphic calcifications	d. Fine linear or fine linear branching	
b. Fine linear or fine linear branching calcifications		
4. Distribution	3. Distribution	Omitted "scattered"
a. Diffuse/scattered	a. Diffuse	Omitted "clustered"
b. Regional	b. Regional	
c. Grouped or clustered	c. Grouped	
d. Linear	d. Linear	
e. Segmental	e. Segmental	
C. Architectural distortion	C. Architectural distortion	
D. Special cases	D. Asymmetries	Added section for asymmetries alone
1. Asymmetric tubular structure/solitary dilated duct	1. Asymmetry	Added "developing asymmetry"
2. Intramammary node	2. Global asymmetry	
3. Global asymmetry	3. Focal asymmetry	
4. Focal asymmetry	4. Developing asymmetry (Fig 5)	
	E. Intramammary lymph node	Separated findings of intramammary lymph node, skin lesion, and solitary dilated duct
	F. Skin lesion	Omitted "asymmetric tubular structure"
	G. Solitary dilated duct	

Figure 1. Chart shows a complete list of changes in the mammography section of the BI-RADS fifth edition. (Fig 1 continues.)

Fourth Edition	Fifth Edition	Changes
E. Associated findings 1. Skin retraction 2. Nipple retraction 3. Skin thickening 4. Trabecular thickening 5. Skin lesion 6. Axillary adenopathy 7. Architectural distortion 8. Calcifications	H. Associated features 1. Skin retraction 2. Nipple retraction 3. Skin thickening 4. Trabecular thickening 5. Axillary adenopathy 6. Architectural distortion 7. Calcifications	Omitted "skin lesion" (made into separate finding)
F. Location of lesion 1. Location 2. Depth	I. Location of lesion 1. Laterality 2. Quadrant and clock face 3. Depth 4. Distance from the nipple	Added specification of "laterality" Added "quadrant and clock face" Added "distance from the nipple"

Figure 1 . (continued) Chart shows a complete list of changes in the mammography section of the BI-RADS fifth edition.

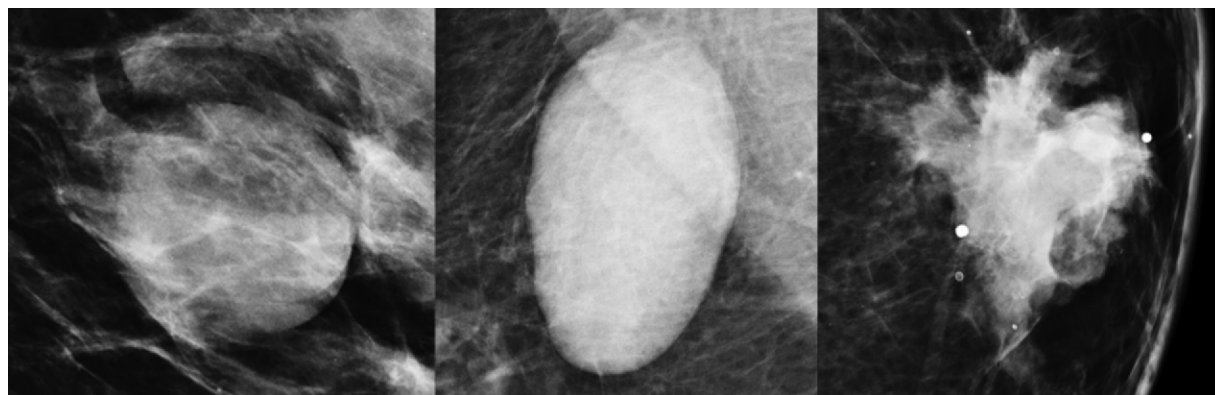


Figure 2. Mass shape. Digital zoom mammographic projection images show, from left to right, round, oval, and irregular masses. An irregular mass has a higher probability of malignancy.

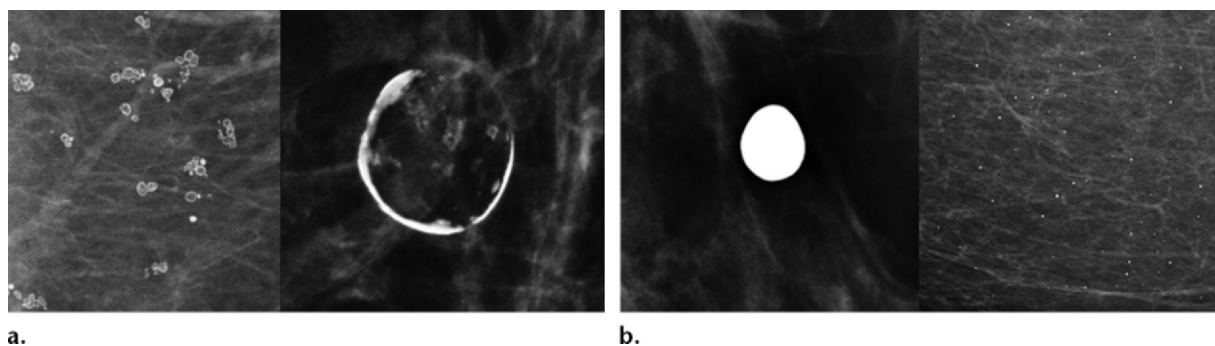


Figure 3. Calcifications. Digital zoom mammographic projection images show changes in categories in the BI-RADS fifth edition. (a) Rim calcifications: Lucent-centered (left) and eggshell (right) calcifications have been combined into one category. (b) Round calcifications: Round (left) and punctate (right) calcifications have been combined into one category.

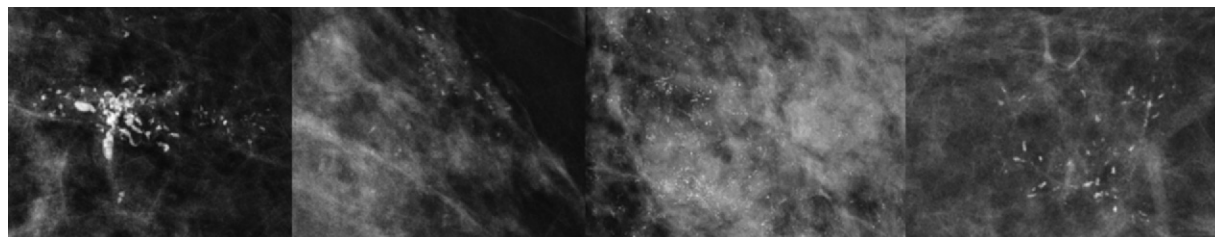


Figure 4. Calcifications with suspicious morphology. Digital zoom mammographic projection images show calcifications with increasing risk for malignancy: coarse heterogeneous (far left), amorphous (second from left), fine pleomorphic (second from right), and fine linear or fine linear branching (far right).

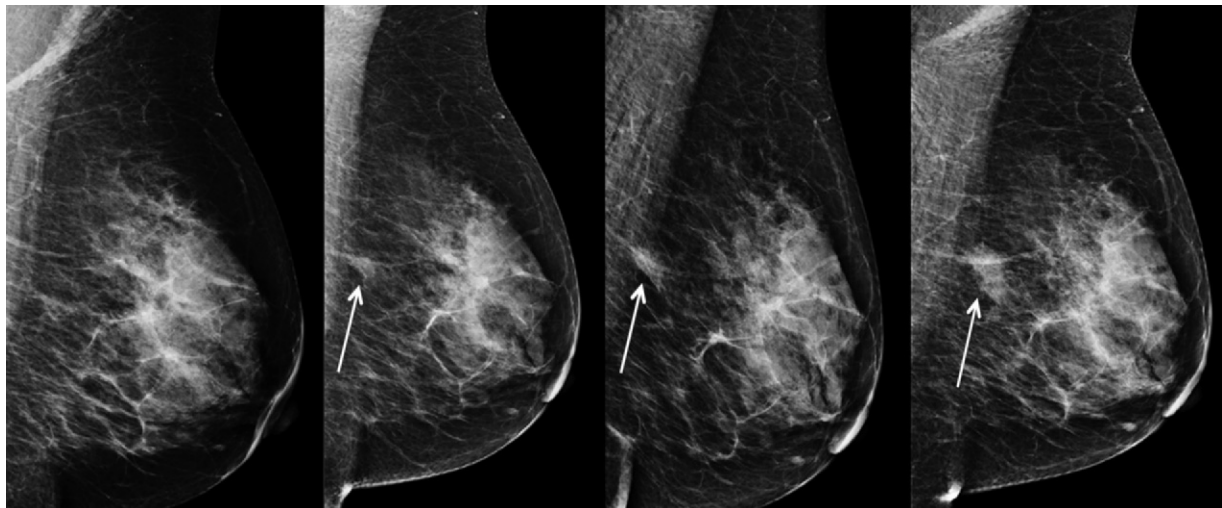


Figure 5. Developing asymmetry. Mediolateral oblique mammograms obtained at annual screenings in the same patient are displayed from oldest (far left) to most recent (far right). An asymmetry in the posterior central left breast (arrows) becomes more conspicuous and increases in size over time. The finding is consistent with a developing asymmetry, a new term added to the mammography lexicon.

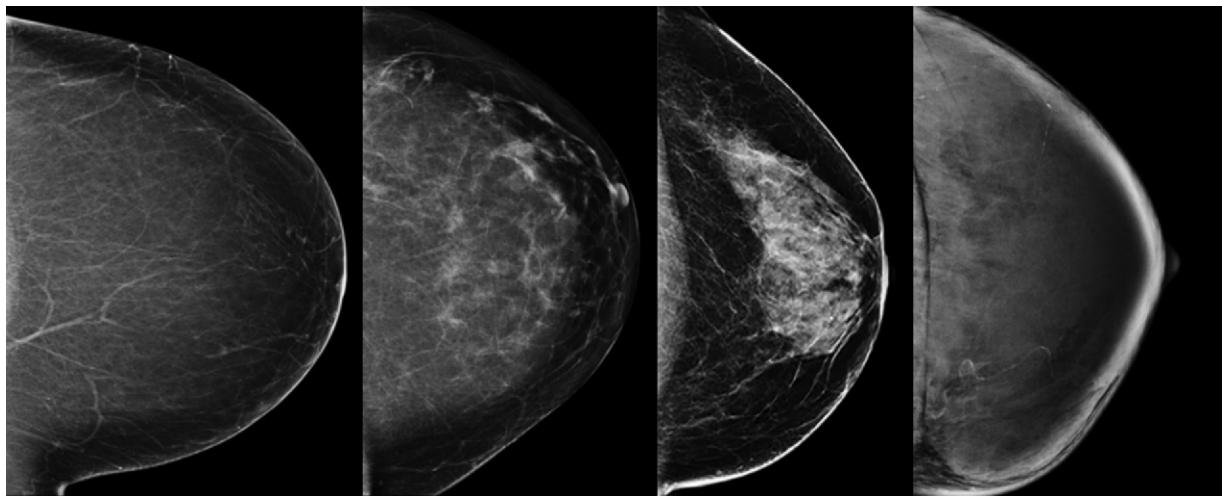


Figure 6. Subjective assessment of breast density. Craniocaudal mammograms show findings characterized as almost entirely fatty (far left), scattered areas of fibroglandular density (second from left), heterogeneously dense (second from right), and extremely dense (far right).

Architectural Distortion

The term *architectural distortion* is unchanged in the fifth edition.

Asymmetries

In addition to asymmetry, focal asymmetry, and global asymmetry, the term *developing asymmetry* has been added to the fifth edition. A developing asymmetry is a focal asymmetry that is new or more conspicuous over time (Fig 5). This term was added to the fifth edition because the finding carries a 12.8% risk for malignancy when seen at screening mammography and a 26.7% risk for malignancy when it persists at diagnostic mammography (3).

Special Cases

The fifth edition has eliminated the term *asymmetric tubular structure*, which is an old term for a dilated duct. The terms *intramammary lymph node*, *skin lesion*, and *solitary dilated duct* remain.

Associated Features

The term *associated features* is used in the lexicon to further characterize masses, calcifications, and asymmetries. The seven associated features in the fifth edition are skin retraction, nipple retraction, skin thickening, trabecular thickening, axillary adenopathy, architectural distortion, and calcifications.

Location of Lesion

The description of lesion location has been expanded in the fifth edition to specifically include the terms *laterality*, *quadrant and clock face*, *depth*, and *distance from the nipple*.

Overview of BI-RADS Fifth Edition: US Revisions

Revisions to the breast US section in the fifth edition include the addition of a new subsection, “general considerations,” which provides an introduction to breast anatomy, US techniques, and factors that optimize US image quality. Changes to the breast US lexicon were made to improve consistency across all modalities, simplify reporting, and reflect advances in technique (eg, the addition of elastography). A complete list of changes to the US lexicon is outlined in Figure 7.

Tissue Composition

At institutions that perform whole-breast screening US, reports should include a descriptor of background breast echotexture, in keeping with mammographic and MR imaging reporting. Although the title of this descriptor has changed from “background echotexture” to “tissue composition,” the three descriptor terms *homogeneous background echotexture—fat*, *homogeneous background echotexture—fibroglandular*, and *heterogeneous background echotexture* remain the same.

Masses

The terms for describing mass shape (*oval*, *round*, and *irregular*), orientation (*parallel* and *not parallel*), and margins (*circumscribed* and *not circumscribed*, with the additional terms *indistinct*, *angular*, *microlobulated*, and *spiculated*) remain unchanged.

The category “lesion boundary” and its descriptor terms *abrupt interface* and *echogenic halo* have been eliminated. The term *echogenic rim* may be included under the term *not circumscribed*, *indistinct* in the margin category because it may not be possible to distinguish an indistinct margin from an echogenic rim.

In the “echo pattern” category, the term *complex* from the fourth edition has been changed to the term *complex cystic and solid* in the fifth edition (Fig 8). A sixth term, *heterogeneous*, has been added (Fig 9). The remaining terms *anechoic*, *hyperechoic*, *hypoechoic*, and *isoechoic* remain unchanged.

The category name “posterior acoustic features” has been simplified to “posterior features,” but the terms *no posterior acoustic features*, *enhancement*, *shadowing*, and *combined pattern* remain unchanged.

The “surrounding tissue” category has been slightly altered and is included in a new category, “associated features.”

Calcifications

The fifth edition has eliminated the micro- versus macrocalcifications distinction and focuses on generalized calcifications by using the terms *calcifications in a mass* and *calcifications outside of a mass*. It also adds a new term, *intraductal calcifications* (Fig 10).

Associated Features

This category was added to the fifth edition to describe a mass’s effect on its surroundings. Although technically a new section, this category pulls from the previous “surrounding tissue” category of the “masses” section and from the “vascularity” section, both of which are eliminated in the fifth edition.

The “associated features” category now includes the terms *architectural distortion* and *edema*, with the previous term *duct* now written as *duct changes*, and the previous terms *skin thickening* and *skin retraction/irregularity* changed to *skin thickening* and *skin retraction* under “skin changes.” The “associated features” category also pulls from the eliminated category “vascularity” and includes the term *vascularity* with three descriptors: *absent*, *internal vascularity*, and *vessels in rim*.

Lastly, this category adds a new section, “elasticity assessment,” with three descriptor choices termed *soft*, *intermediate*, and *hard*. Elasticity may be assessed by strain, which refers to manual compression of the mass and is measured in kilopascals, or by speed of propagation of shear waves, which refers to introduced ultrasonic energy into the mass and is measured in meters per second. For sites that use elasticity assessment in clinical practice, the descriptors, rather than the color seen, should be used because there is no standardized color scale.

Special Cases

The “special cases” category has been expanded in the fifth edition. The previous terms *clustered microcysts*, *complicated cysts*, *mass in or on skin*, *lymph nodes—intramammary*, and *lymph nodes—axillary* remain unchanged, with the term *foreign body* now specifically including implants. Four new terms have been added to the US “special cases” category: *simple cyst*, *vascular abnormalities* (with the additional terms *arteriovenous malformations* and *Mondor disease*), *postsurgical fluid collection*, and *fat necrosis* (Fig 11).

Overview of BI-RADS Fifth Edition: MR Imaging Revisions

The fifth edition of the MR imaging lexicon adds descriptors for the amount of fibroglandular tissue and background parenchymal enhancement.

Fourth Edition	Fifth Edition	Changes
A. Background echotexture	A. Tissue composition	Renamed
1. Homogeneous background echotexture—fat	1. Homogeneous background echotexture—fat	
2. Homogeneous background echotexture—fibroglandular	2. Homogeneous background echotexture—fibroglandular	
3. Heterogeneous background	3. Heterogeneous background echotexture	
B. Masses	B. Masses	
1. Shape	1. Shape	
a. Oval	a. Oval	
b. Round	b. Round	
c. Irregular	c. Irregular	
2. Orientation	2. Orientation	
a. Parallel	a. Parallel	
b. Not parallel	b. Not parallel	
3. Margin	3. Margin	
a. Circumscribed	a. Circumscribed	
b. Not circumscribed	b. Not circumscribed	
i. Indistinct	i. Indistinct	
ii. Angular	ii. Angular	
iii. Microlobulated	iii. Microlobulated	
iv. Spiculated	iv. Spiculated	
4. Lesion boundary	4. Echo pattern	Omitted “lesion boundary” category
a. Abrupt interface	a. Anechoic	Changed “complex” to “complex cystic and solid”
b. Echogenic halo	b. Hyperechoic	Added “heterogeneous” descriptor for echo pattern
5. Echo pattern	c. Complex cystic and solid (Fig 8)	
a. Anechoic	d. Hypoechoic	
b. Hyperechoic	e. Isoechoic	
c. Complex	f. Heterogeneous (Fig 9)	
d. Hypoechoic	5. Posterior features	Omitted “surrounding tissue” category (some descriptors added to section D)
e. Isoechoic	a. No posterior acoustic features	
6. Posterior acoustic features	b. Enhancement	
a. No posterior acoustic features	c. Shadowing	
b. Enhancement	d. Combined pattern	
c. Shadowing		
d. Combined pattern		
7. Surrounding tissue		
a. Ducts		
b. Changes in Cooper ligaments		
c. Edema		
d. Architectural distortion		
e. Skin thickening		
f. Skin retraction/irregularity		
C. Calcifications	C. Calcifications	Omitted micro/macro distinction
1. Macrocalcifications	1. Calcifications in a mass	Added “intraductal”
2. Microcalcifications	2. Calcifications outside of a mass	
a. Microcalcifications out of a mass	3. Intraductal calcifications (Fig 10)	
b. Microcalcifications in a mass		
	D. Associated features	Added “associated features” category (includes descriptors from previous “lesion boundary” and “vascularity” categories)
	1. Architectural distortion	Added descriptors for elasticity assessment
	2. Duct changes	
	3. Skin changes	
	a. Skin thickening	
	b. Skin retraction	
	4. Edema	
	5. Vascularity	
	a. Absent	
	b. Internal vascularity	
	c. Vessels in rim	

Figure 7. Chart shows a complete list of changes in the US section of the BI-RADS fifth edition. (Fig 7 continues.)

Fourth Edition	Fifth Edition	Changes
	6. Elasticity assessment <ol style="list-style-type: none"> Soft Intermediate Hard 	
D. Special cases <ol style="list-style-type: none"> 1. Clustered microcysts 2. Complicated cysts 3. Mass in or on skin 4. Foreign body 5. Lymph nodes— intramammary 6. Lymph nodes—axillary 	E. Special cases (Fig 11) <ol style="list-style-type: none"> 1. Simple cyst 2. Clustered microcysts 3. Complicated cysts 4. Mass in or on skin 5. Foreign body, including implants 6. Lymph nodes—intramammary 7. Lymph nodes—axillary 8. Vascular abnormalities <ol style="list-style-type: none"> a. Arteriovenous malformations b. Mondor disease 9. Postsurgical fluid collection 10. Fat necrosis 	Expanded “special cases”
E. Vascularity <ol style="list-style-type: none"> 1. Present or not present 2. Present immediately adjacent to lesion 3. Diffusely increased vascularity in surrounding tissue 		Omitted dedicated “vascularity” section

Figure 7. (continued) Chart shows a complete list of changes in the US section of the BI-RADS fifth edition.

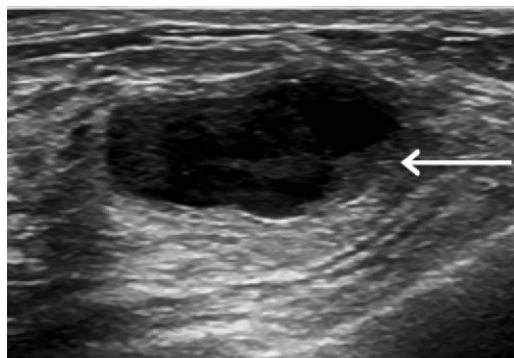


Figure 8. Complex cystic and solid mass. Gray-scale US image shows an irregular mass with circumscribed margins (arrow) that contains both solid and cystic components. Note the increased through transmission. The finding was a biopsy-proven abscess.

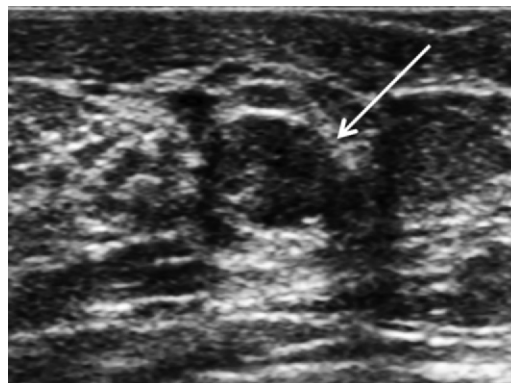


Figure 9. Heterogeneous echo pattern. Gray-scale US image shows a solid mass with hypoechoic and hyperechoic components (arrow) that are consistent with a heterogeneous echo pattern.

Some terms used to describe masses and nonmass enhancements have been consolidated in the new edition. The “associated findings” section from the fourth edition has been expanded into six sections, which include nonenhancing findings and fat-containing lesions. Finally, the fifth edition adds an extensive section for implant descriptors. The complete list of changes to the MR imaging lexicon is shown in Figure 12.

New Sections

The amount of fibroglandular tissue in the breast is described as almost entirely fat, scat-

tered, heterogeneous, or extreme in the fifth edition, in keeping with the descriptors for mammographic breast density (Fig 13).

A section describing background parenchymal enhancement has been added. Diffuse evenly distributed foci are now considered background enhancement. Visual estimation of normal background parenchymal enhancement seen with the first contrast-enhanced sequence is classified as minimal, mild, moderate, or marked (Fig 14). Enhancement is either symmetric or asymmetric. No substantial differences in cancer detection rates or biopsy rates exist

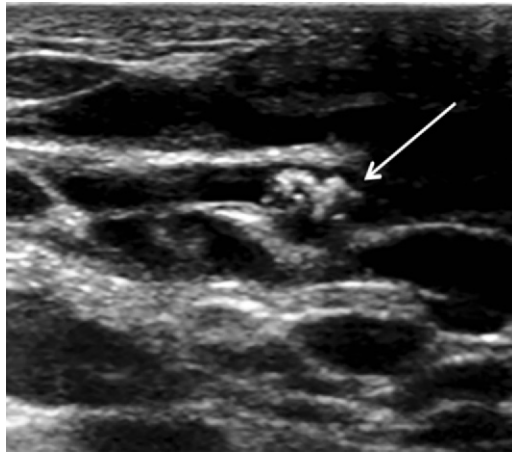


Figure 10. Gray-scale US image shows intraductal calcifications (arrow).

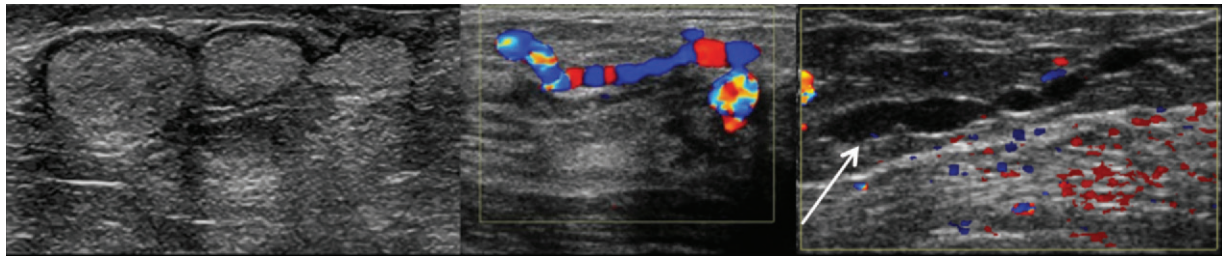


Figure 11. Special cases at US. Three new terms in the “special cases” category are shown: Gray-scale US image (left) shows fat necrosis, and color Doppler US images (center and right) show vascular abnormalities of arteriovenous malformations (center) and Mondor disease (right; arrow).

among the different background parenchymal enhancement categories (4).

Focus

In the fourth edition, mass and foci were differentiated by size. Findings smaller than 5 mm were defined as a focus, while findings larger than 5 mm were defined as a mass. The fifth edition no longer uses size criteria and instead uses morphology. The presence of margins and shape defines a mass, and a focus is a specific, isolated, enhancing dot that is too small to be assigned morphologic descriptors.

Masses

Shape descriptors have been reduced to *oval*, *round*, and *irregular*, with *lobulated* consolidated into *oval*. This change recapitulates the descriptors seen in the mammography and US lexicons. Descriptors for margins have been lumped into two categories: circumscribed and not circumscribed. Smooth margins are now *circumscribed*; irregular and spiculated margins are *not circumscribed*.

In the description of internal enhancements, the terms *central enhancement* and *enhancing internal septations* have been eliminated.

Nonmass Enhancement

Categories for the distribution of nonmass enhancement include focal, linear, segmental, region-

al, multiple regions, and diffuse. The term *ductal enhancement* has been eliminated.

Internal enhancement patterns of nonmass enhancement include homogeneous, heterogeneous, clumped, and clustered ring. The previous term *reticular/dendritic enhancement* is now *clustered ring* (Fig 15). The term *stippled/punctate enhancement* has been eliminated in the fifth edition.

Associated Findings

The “associated findings” section from the fourth edition has been expanded and subcategorized into six new sections: “intramammary lymph node,” “skin lesion,” “nonenhancing findings” (seven items), “associated findings” (nine items), “fat-containing lesions” (four items), and “implants.”

Intramammary lymph nodes (Fig 16) and skin lesions (Fig 17) are now reportable MR imaging findings. They are new additions to the fifth edition.

Nonenhancing findings now strictly include findings associated with surgical changes and treatment effects or truly nonenhancing findings. They include the following terms: *ductal high signal intensity on precontrast T1-weighted images* (Fig 18a), which could represent proteinaceous fluid or blood in the duct; *cyst* (Fig 18b); *postoperative collections (hematoma/seroma)* (Fig 18c); *posttherapy skin thickening and trabecular thickening* (Fig 18d);

Fourth Edition	Fifth Edition	Changes
	A. Amount of fibroglandular tissue (Fig 13) <ol style="list-style-type: none"> 1. Almost entirely fat 2. Scattered fibroglandular tissue 3. Heterogeneous fibroglandular tissue 4. Extreme fibroglandular tissue 	Added this section
	B. Background parenchymal enhancement (Fig 14) <ol style="list-style-type: none"> 1. Level <ol style="list-style-type: none"> a. Minimal b. Mild c. Moderate d. Marked 2. Symmetric or asymmetric <ol style="list-style-type: none"> a. Symmetric b. Asymmetric 	Added this section
A. Focus/Foci	C. Focus	Changed definition of "focus"
B. Mass <ol style="list-style-type: none"> 1. Shape <ol style="list-style-type: none"> a. Round b. Oval c. Lobulated d. Irregular 2. Margin <ol style="list-style-type: none"> a. Smooth margin b. Irregular margin c. Spiculated margin 3. Internal enhancement characteristics <ol style="list-style-type: none"> a. Homogeneous b. Heterogeneous c. Rim enhancement d. Dark internal septations e. Enhancing internal septations f. Central enhancement 	D. Masses <ol style="list-style-type: none"> 1. Shape <ol style="list-style-type: none"> a. Oval (includes lobulated) b. Round c. Irregular 2. Margin <ol style="list-style-type: none"> a. Circumscribed b. Not circumscribed <ol style="list-style-type: none"> i. Irregular ii. Spiculated 3. Internal enhancement characteristics <ol style="list-style-type: none"> a. Homogeneous b. Heterogeneous c. Rim enhancement d. Dark internal septations 	Omitted "lobulated"
C. Non-mass-like enhancement <ol style="list-style-type: none"> 1. Distribution <ol style="list-style-type: none"> a. Focal area b. Linear enhancement c. Ductal enhancement d. Segmental enhancement e. Regional enhancement f. Multiple regions of enhancement g. Diffuse enhancement 2. Internal enhancement patterns <ol style="list-style-type: none"> a. Homogeneous enhancement b. Heterogeneous enhancement c. Stippled/punctate enhancement d. Clumped enhancement e. Reticular/dendritic enhancement 3. Symmetric or asymmetric <ol style="list-style-type: none"> a. Symmetric b. Asymmetric 	E. Nonmass enhancement <ol style="list-style-type: none"> 1. Distribution <ol style="list-style-type: none"> a. Focal b. Linear c. Segmental d. Regional e. Multiple regions f. Diffuse 2. Internal enhancement patterns <ol style="list-style-type: none"> a. Homogeneous b. Heterogeneous c. Clumped d. Clustered ring (Fig 15) 	Omitted "ductal" Omitted "stippled/punctate" Added/replaced "clustered ring"
	F. Intramammary lymph node (Fig 16)	
	G. Skin lesion (Fig 17)	
	H. Nonenhancing findings (Fig 18) <ol style="list-style-type: none"> 1. Ductal high signal intensity on precontrast T1-weighted images 2. Cyst 3. Postoperative collections (hematoma/seroma) 	Separated "associated findings" into "nonenhancing findings," "associated findings," and "fat-containing lesions"

Figure 12. Chart shows a complete list of changes in the MR imaging section of the BI-RADS fifth edition. (Fig 12 continues.)

Fourth Edition	Fifth Edition	Changes
	4. Posttherapy skin thickening and trabecular thickening 5. Nonenhancing mass 6. Architectural distortion 7. Signal void from foreign bodies, clips, etc	
D. Associated findings 1. Nipple retraction or inversion 2. Ductal precontrast high signal intensity 3. Skin retraction 4. Skin thickening 5. Skin invasion 6. Edema 7. Lymphadenopathy 8. Pectoralis muscle invasion 9. Chest wall invasion 10. Hematoma/blood 11. Abnormal signal void 12. Cyst	I. Associated findings (Fig 19) 1. Nipple retraction 2. Nipple invasion 3. Skin retraction 4. Skin thickening 5. Skin invasion a. Direct invasion b. Inflammatory cancer 6. Axillary adenopathy 7. Pectoralis muscle invasion 8. Chest wall invasion 9. Architectural distortion	
	J. Fat-containing lesions (Fig 20) 1. Lymph nodes a. Normal b. Abnormal 2. Fat necrosis 3. Hamartoma 4. Postoperative seroma/hematoma with fat	
E. Lesion location 1. Locations 2. Depth	K. Location of lesion 1. Location 2. Depth	
F. Kinetic curve assessment 1. Sample for and report on the worst-looking kinetic curve 2. Signal intensity/time curve description a. Initial enhancement phase i. Slow ii. Medium iii. Rapid b. Delayed phase i. Persistent ii. Plateau iii. Washout	L. Kinetic curve assessment Signal intensity/time curve description 1. Initial phase a. Slow b. Medium c. Fast 2. Delayed phase a. Persistent b. Plateau c. Washout	Changed "rapid" to "fast"
	M. Implants (Fig 21) 1. Implant material and lumen type a. Saline b. Silicone i. Intact ii. Ruptured c. Other implant material d. Lumen type 2. Implant location a. Retroglandular b. Retropectoral 3. Abnormal implant contour a. Focal bulge 4. Intracapsular silicone findings a. Radial folds b. Subcapsular line c. Keyhole sign d. Linguine sign 5. Extracapsular silicone a. Breast b. Lymph nodes 6. Water droplets 7. Peri-implant fluid	Added "implants" section

Figure 12. (continued) Chart shows a complete list of changes in the MR imaging section of the BI-RADS fifth edition.

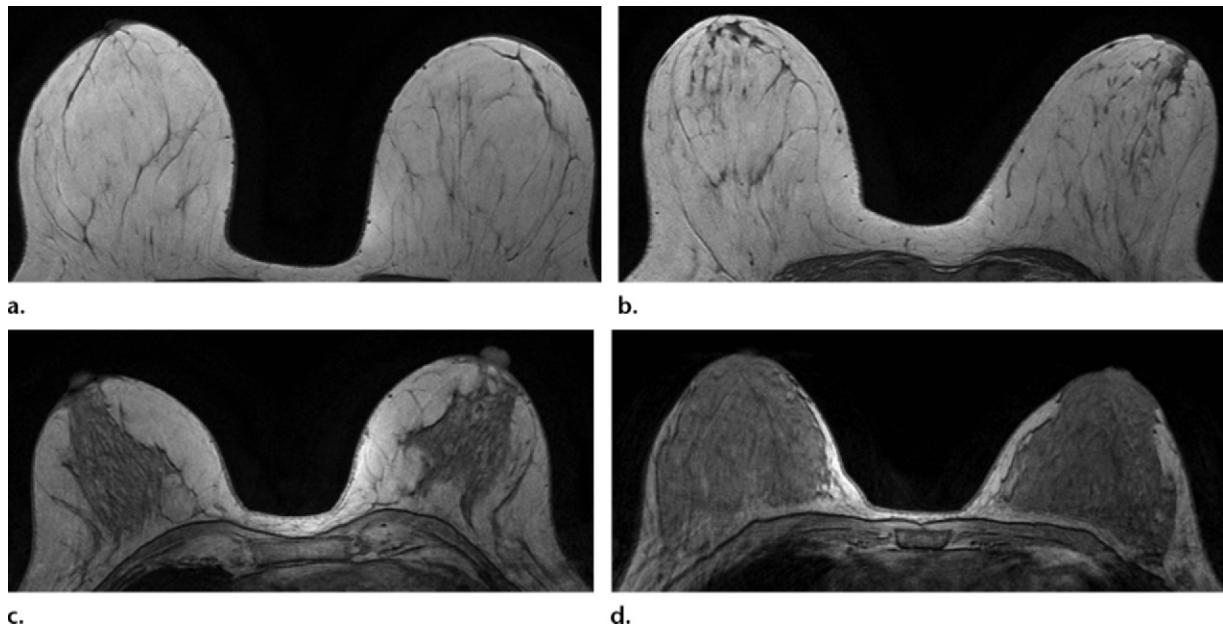


Figure 13. Fibroglandular tissue. This new section translates mammographic density into fibroglandular tissue quantity at MR imaging. Axial nonenhanced T1-weighted MR images show the following descriptors: almost entirely fat (**a**), scattered fibroglandular tissue (**b**), heterogeneous fibroglandular tissue (**c**), and extreme fibroglandular tissue (**d**).

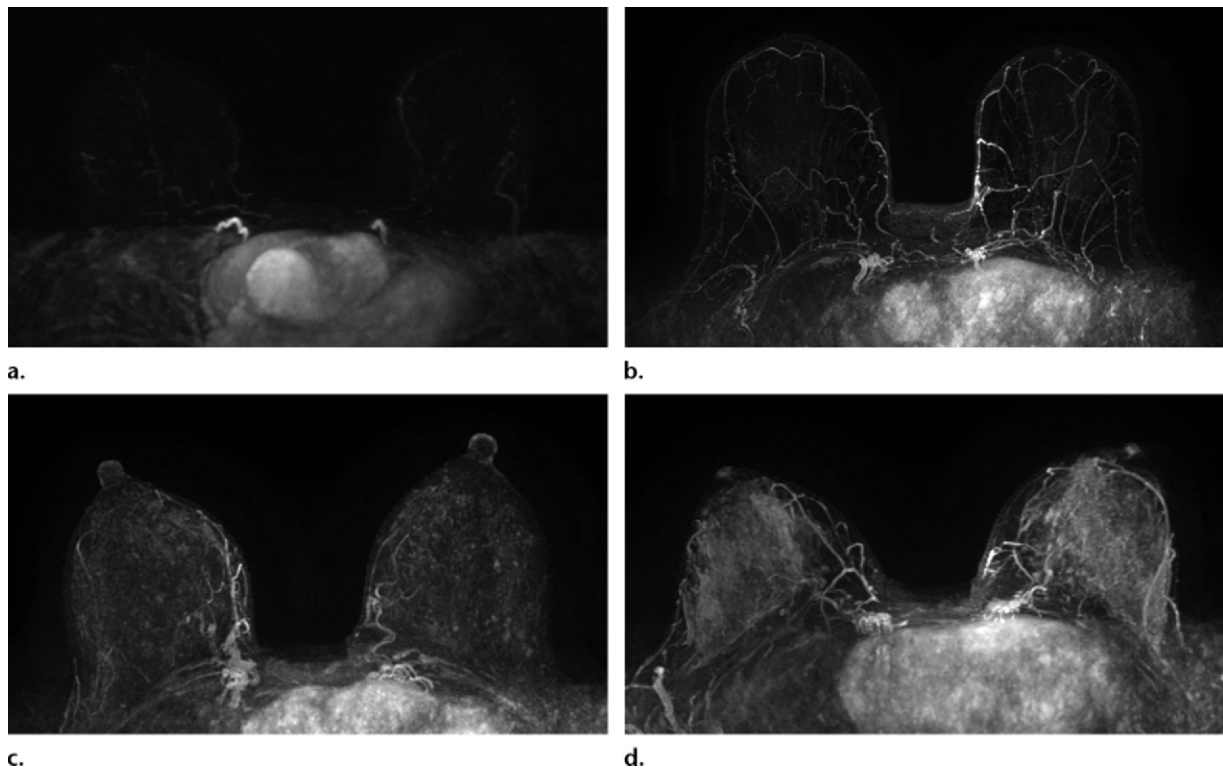


Figure 14. Background parenchymal enhancement. This descriptor is a visual estimate of the amount of enhancement. Axial contrast-enhanced maximum intensity projection MR images show minimal (**a**), mild (**b**), moderate (**c**), and marked (**d**) enhancement.

nonenhancing mass (Fig 18e), which, in the setting of multiple and bilateral masses, is a benign finding; *architectural distortion* (Fig 18f), most often a scar; and *signal void from foreign bodies, clips, etc*, best seen with T1-weighted sequences.

In contrast, the “associated findings” section that appears in the fifth edition categorically

contains items associated with malignancy. These include the terms *nipple retraction* (Fig 19a), *nipple invasion*, *skin retraction* (Fig 19b), *skin thickening*, *skin invasion* (direct invasion and inflammatory cancer), *axillary adenopathy* (Fig 19c), *pectoralis muscle invasion*, *chest wall invasion* (Fig 19d), and *architectural distortion*.

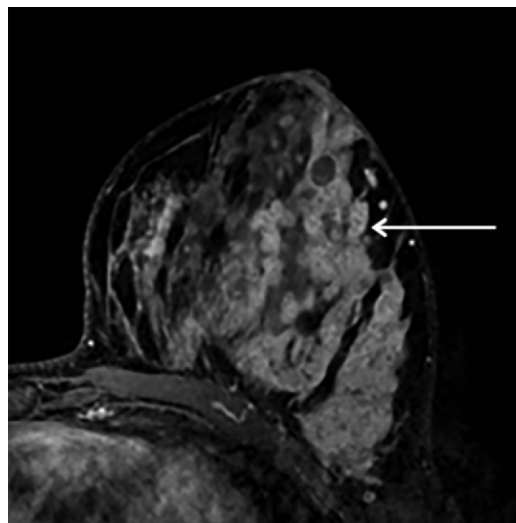


Figure 15. Clustered ring. This new term describes internal enhancement that previously was included in the term *reticular/dendritic enhancement*. Axial contrast-enhanced T1-weighted delayed MR image shows diffuse clustered ring enhancement (arrow) in a patient with biopsy-proven ductal carcinoma in situ.

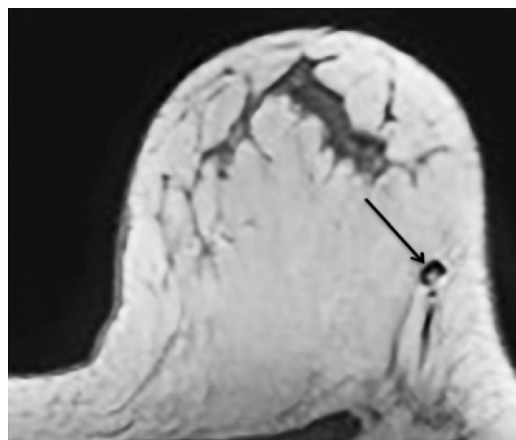


Figure 16. Intramammary lymph node. Axial nonenhanced T1-weighted MR image shows an intramammary lymph node (arrow), a finding characterized by a reniform shape and fatty hilum. Lymph nodes typically are hyperintense on T2-weighted images and are located adjacent to blood vessels.

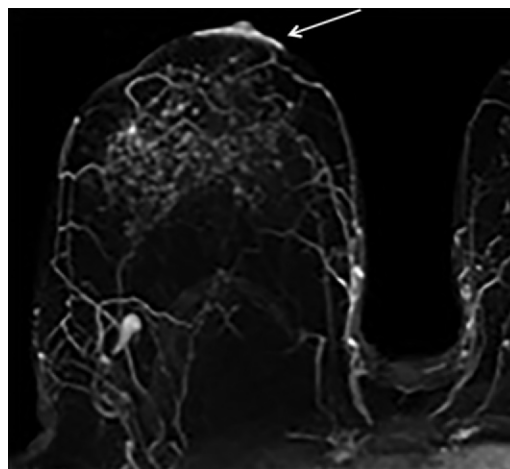


Figure 17. Skin lesion. Axial contrast-enhanced maximum intensity projection MR image shows punch biopsy-proven eczema of the right nipple-areolar complex manifesting with skin thickening and enhancement (arrow).

A section on fat-containing lesions has been introduced in the fifth edition. This section notes normal and abnormal lymph nodes, fat necrosis (Fig 20a), hamartoma (Fig 20b), and postoperative seroma or hematoma with fat.

Location of Lesion

The “location of lesion” section is unchanged between the fourth and fifth editions.

Kinetic Curve Assessment

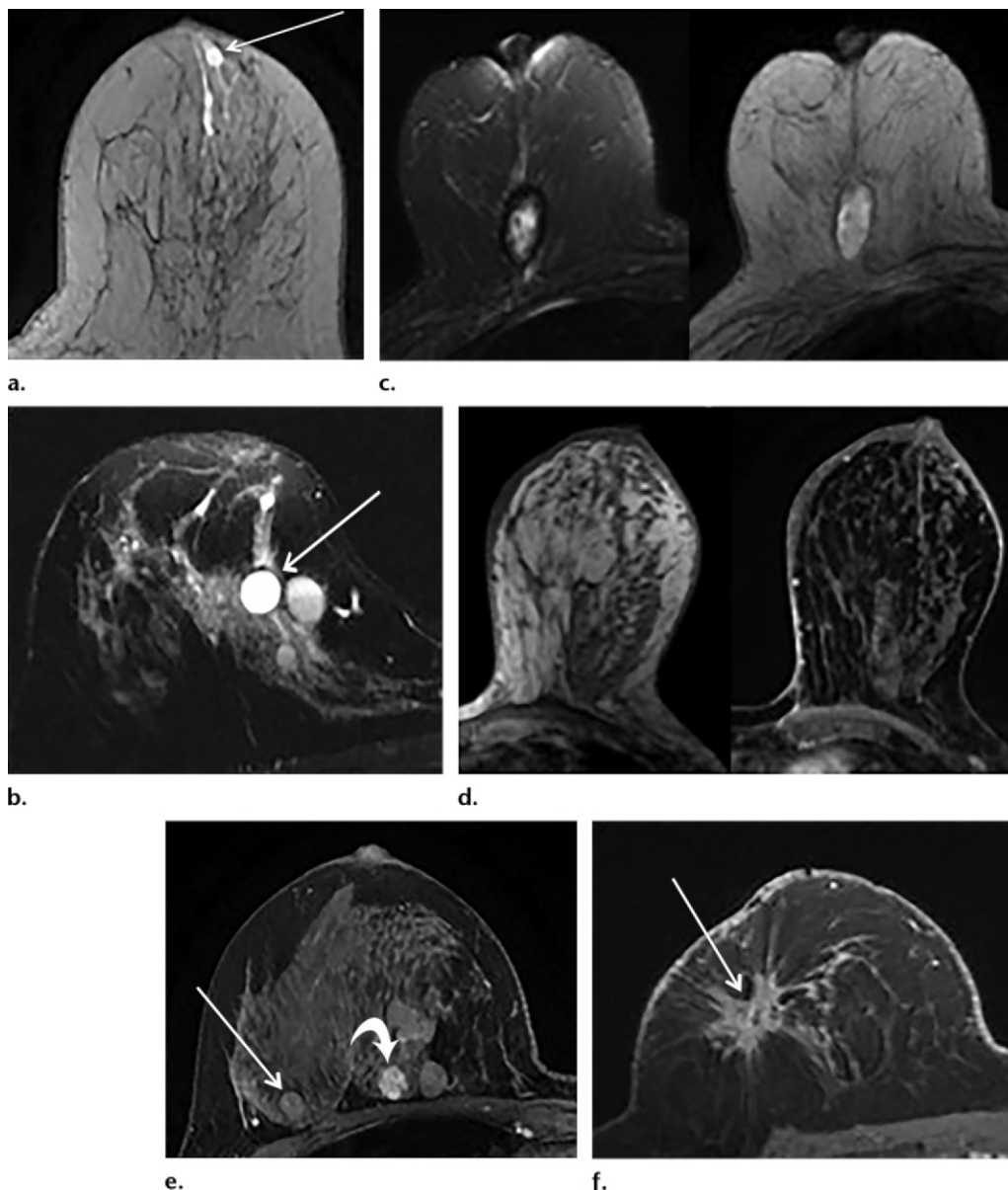
The terminology in the “kinetic curve assessment” section remains similar. The initial phase, which occurs within the first 2 minutes or when the curve starts to change, is described by the terms *slow*, *medium*, or *fast* (previously *rapid*). The delayed portion, which occurs after 2 minutes or after the curve starts to change, is described as *persistent*, *plateau*, or *washout*.

Of note, the fifth edition has incorporated percentage parameters to define each descriptor. In the initial phase, *slow* is defined as an increase in signal intensity of less than 50% within the first 2 minutes, *medium* is a 50%–100% increase, and *fast* is an increase of more than 100%. During the delayed phase, *persistent* is defined as a continued increase in signal intensity of more than 10% over time. *Plateau* remains a qualitative description, defined as signal intensity that does not change over time after the initial rise. *Washout* during the delayed phase is defined as a decrease of more than 10% from the highest signal intensity during the initial rise. Washout curves are specifically denoted “suspicious.”

MR Imaging: Implants

There are two indications for breast MR imaging: evaluation for presence or extent of malignancy, and evaluation of silicone implant integrity. The

Figure 18. Nonenhancing findings. Axial MR images show six of the seven nonenhancing findings described in the new lexicon: ductal high signal intensity (arrow), seen on a precontrast T1-weighted image (**a**); cyst (arrow), seen on a fat-saturated T2-weighted image (**b**); postoperative collection (hematoma), seen on fat-saturated T2-weighted (left) and non-fat-saturated T1-weighted (right) images (**c**); posttreatment skin thickening and trabecular thickening, seen on non-fat-saturated (left) and contrast-enhanced fat-saturated delayed (right) T1-weighted images (**d**); nonenhancing mass (straight arrow; curved arrow indicates an enhancing mass), seen on a contrast-enhanced fat-saturated delayed image (**e**); and architectural distortion (arrow), seen on a contrast-enhanced fat-saturated delayed image (**f**). The seventh descriptor, signal void from foreign bodies, is not shown.



use of silicone implants for cosmesis was halted by the U.S. Food and Drug Administration (FDA) in 1992 because of concern that silicone implants were associated with connective tissue disease and breast cancer. After further study showed that no association existed (5,6), the FDA reinstated the use of silicone implants for cosmesis in 2008. The new BI-RADS MR imaging lexicon contains descriptors to standardize findings related to silicone breast implants.

Implant material is identified according to its signal intensity as saline, silicone, or other im-

plant material, which includes injected silicone. Silicone implants may be intact or ruptured. Lumen type can be described as single or double lumen. Implant location is described as retroglan-dular or retropectoral. The term *focal bulge* is the only descriptor for abnormal implant contour.

Intracapsular silicone findings include radial folds, which are normal folds of the implant, and subcapsular line, “keyhole” sign, and “linguine” sign, which denote intracapsular rupture (Fig 21). Extracapsular silicone, if present, is noted to be in the breast or lymph nodes (Fig 21). Water

Figure 19. Associated findings. This category is usually associated with malignancy. (a, b) Axial contrast-enhanced fat-saturated delayed MR images show nipple retraction and invasion (arrow in a) and skin retraction (arrow in b). (c) Axial T2-weighted MR subtraction image shows axillary adenopathy (arrow). (d) Axial contrast-enhanced fat-saturated delayed MR image shows chest wall invasion, characterized by enhancement of the pectoralis muscle (curved arrow) and intercostal muscles (straight arrow).

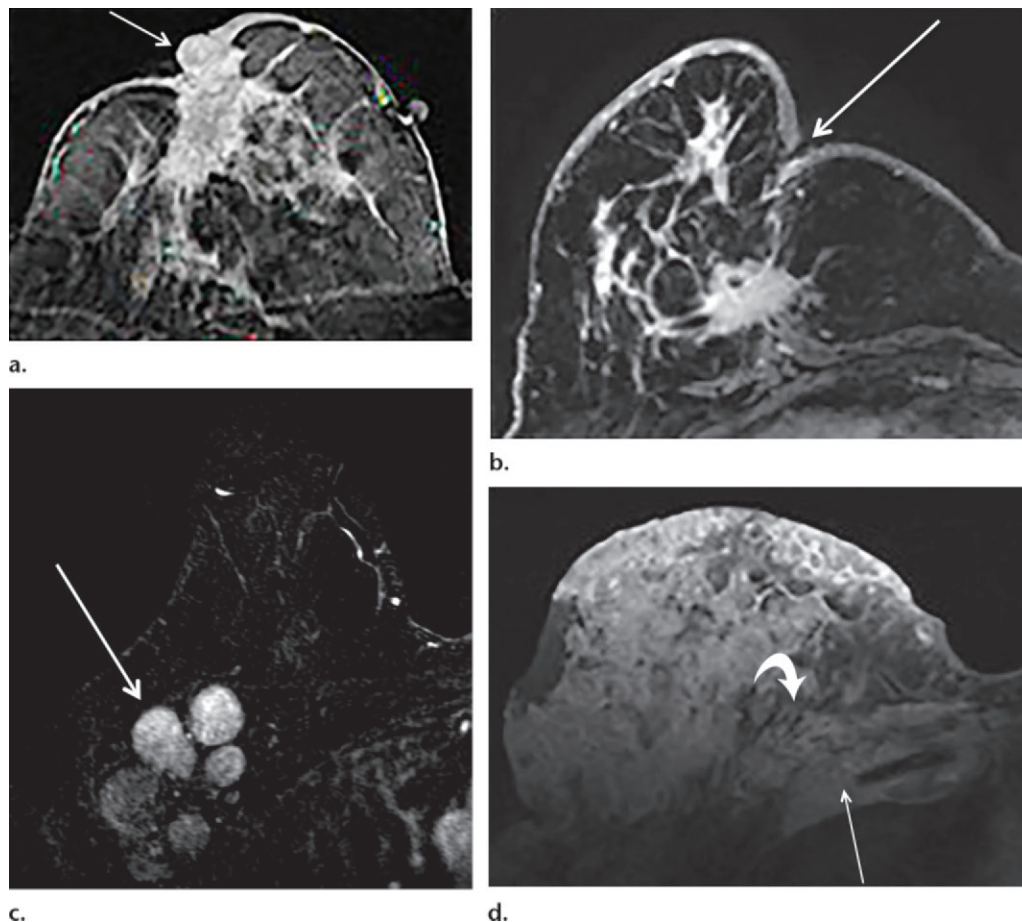
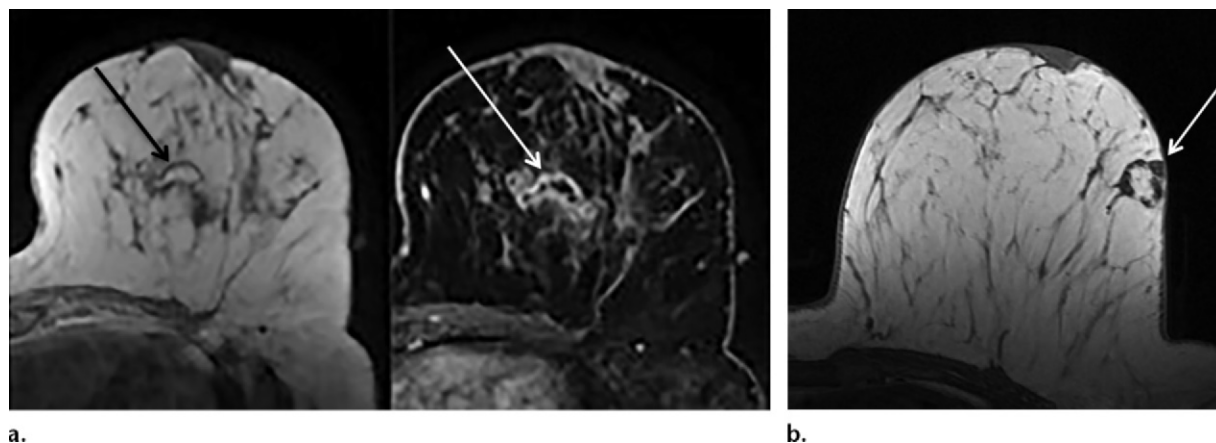


Figure 20. Fat-containing lesions. (a) Axial T1-weighted (left) and contrast-enhanced fat-saturated delayed (right) MR images show fat necrosis, characterized by findings of peripheral enhancement and central fat signal intensity (arrows). (b) Axial T1-weighted MR image shows a hamartoma (arrow), which was also fat containing on a mammogram (not shown).



droplets and peri-implant fluid are also reportable. If a nonenhanced implant integrity study is performed, a BI-RADS assessment category should not be reported.

Assessment Categories

The major change to the assessment categories is the subdivision of category 4 lesions into categories 4A, 4B, and 4C for mammographic and

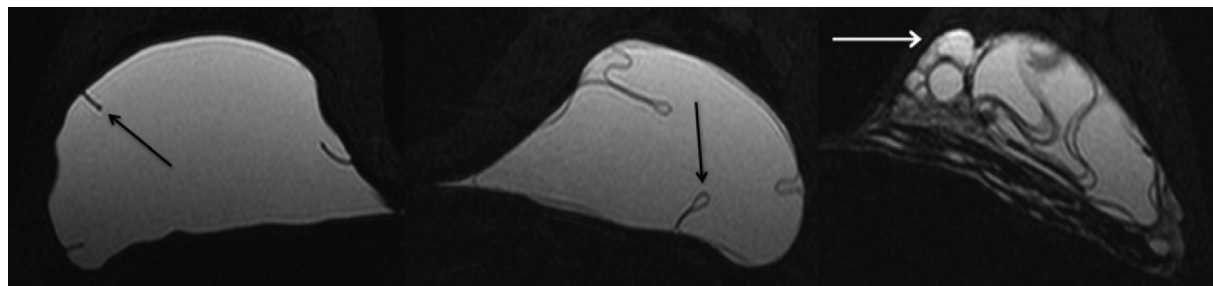


Figure 21. Implant findings. Although breast MR imaging has been used for evaluation of silicone gel implant integrity, the fifth edition is the first to include descriptors for implants. Axial silicone-specific water-suppressed MR images in a patient with both intra- and extracapsular rupture show intact implant radial folds (arrow in left image), intracapsular rupture with keyhole sign (arrow in center image), and extracapsular silicone in the breast (arrow in right image).

Fourth Edition	Fifth Edition	Changes
Category 0: Need additional imaging evaluation and/or prior mammograms for comparison	Category 0: Incomplete—need additional imaging evaluation and/or prior mammograms for comparison	
Category 1: Negative	Category 1: Negative	
Category 2: Benign finding(s)	Category 2: Benign	
Category 3: Probably benign finding—initial short-interval follow-up suggested	Category 3: Probably benign	
Category 4: Suspicious abnormality—biopsy should be considered	Category 4: Suspicious A. Low suspicion for malignancy B. Moderate suspicion for malignancy C. High suspicion for malignancy	Added subclassifications under “suspicious”
Category 5: Highly suggestive of malignancy—appropriate action should be taken	Category 5: Highly suggestive of malignancy	Recommendation removed
Category 6: Known biopsy-proven malignancy—appropriate action should be taken	Category 6: Known biopsy-proven malignancy	Recommendation removed

Figure 22. Chart shows changes to assessment categories in the BI-RADS fifth edition.

sonographic findings. These categories represent low suspicion for malignancy, moderate suspicion for malignancy, and high suspicion for malignancy, respectively. Categories 4A, 4B, and 4C are not used for MR imaging findings. In addition, BI-RADS category 3 is evolving in breast MR imaging, with insufficient data to recommend which findings are likely to be benign. BI-RADS category 3 is used on the basis of the interpreting radiologist’s experience. The complete list of changes to the assessment categories is shown in Fig 22.

Guidance Subsection

Each of the three modalities sections includes a guidance subsection. In this subsection, useful information is provided that is not intended as standard or practice but rather as advice or clarification. Included in these subsections are frequently asked questions (FAQs) (1). The

FAQs address topics such as how to assess axillary adenopathy if there are no suspicious findings in the breasts and how to describe a mass within a duct in the setting of spontaneous bloody discharge from the nipple.

Improvements

Improvements to the fifth edition of the BI-RADS lexicon include the ability to download a quick reference card and poster from the ACR website and print them for personal use. Additional improvements include the option to purchase the BI-RADS book, e-book, or a combination of both at a discount.

Conclusion

The BI-RADS lexicon can be used to predict benign and malignant disease, eliminate ambiguity, allow automated data collection, and facilitate

concise communication with referring physicians and radiologists across facilities. The fifth edition reorganizes and consolidates terminology from the fourth edition and significantly expands the MR imaging lexicon. As a “living” document, the BI-RADS lexicon allows for updates as future research and data inevitably change practice patterns. We expect to see future editions of the BI-RADS atlas in the years to come.

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