Current Problems in Diagnostic Radiology 46 (2017) 26–34

Current Problems in Diagnostic Radiology

journal homepage: www.cpdrjournal.com

Interpretation of Breast MRI Utilizing the BI-RADS Fifth Edition Lexicon: How Are We Doing and Where Are We Headed?

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The Breast Imaging Reporting and Data System (BI-RADS) was first initiated in the late 1980s in order to standardize reporting, improve report organization, and to monitor outcomes for more clear, concise, and uniform communication of breast imaging findings. In the BI-RADS 5th edition, several changes and new additions have been made to the magnetic resonance imaging (MRI) lexicon, reflecting increased utilization and availability of breast MRI in clinical practice. Understanding the role and appropriate utilization of breast MRI and the BI-RADS lexicon could help with interpretation and effective communication of MRI findings as well as preparing for incorporation of more advanced imaging techniques. In this comprehensive review of the changes and new descriptors in the MRI section of the fifth edition of BI-RADS with pictorial examples, the reader would be able to achieve improved understanding of the MRI BI-RADS lexicon and its appropriate applications.

Introduction

The Breast Imaging Reporting and Data System (BI-RADS) was first introduced by the American College of Radiology in 1993, as mandated by the Mammography Quality and Standards Act.[1] The objective was to standardize reporting terminology, improve report organization, and outcome monitoring to allow for communication of breast imaging findings in a more clear, consistent, and succinct manner. Despite some controversies in the 1990s regarding the more strict and standardized use of terminology recommended by BI-RADS, the BI-RADS lexicon has been very successfully implemented in interpretation of breast imaging studies both nationally and internationally.[1] Increased standardization of the lexicon in mammography, ultrasound, and magnetic resonance imaging (MRI) along with efforts to provide evidence-based justification for the management recommendations not only helped with clinical implementation of the BI-RADS lexicon, but it also led to the development of robust research in breast imaging with consistent and uniform usage of a standardized lexicon. BI-RADS has been an evolutionary process, continuously changing, starting from the mammography lexicon in its first edition in 1993, to include ultrasound and MRI in its fourth edition in 2003, and with the most comprehensive fifth edition becoming available recently.[1-3] Several changes and additions were made in this new edition, predominantly involving the breast MRI section. In this article, we present a comprehensive review of the changes and new descriptors added in the BI-RADS fifth edition for breast MRI with pictorial examples. This review hopes to improve understanding of the role of breast MRI and how to appropriately utilize the lexicon. We believe that appropriate application of the BI-RADS fifth edition lexicon can help with interpretation of MRI, and use of the BI-RADS lexicon may help to prepare for incorporation of more advanced imaging techniques and research.

Role of Breast MRI

Contrast-enhanced breast MRI has shown to be the most sensitive imaging modality for detection of breast cancer in numerous studies, but breast MRI is only moderately specific.[4-6] Because of its high sensitivity but yet moderate specificity, it becomes important for radiologists to know the indications for proper utilization of breast MRI and to make appropriate recommendations for MRI in clinical practice. The most frequent indication for breast MRI is high-risk screening for patients with a 20% or greater lifetime risk of developing breast cancer. Other indications include evaluation of extent of disease and screening of the contralateral breast in patients with newly diagnosed primary breast cancer, evaluation of metastatic axillary lymphadenopathy with an unknown primary tumor, evaluation of residual disease post breast conservation surgery with positive margins, monitoring of response to neoadjuvant chemotherapy, locoregional recurrence evaluation, problem solving after inconclusive mammography without a sonographic correlate, suspicious nipple discharge without a mammographic, sonographic and galactographic correlate, and silicone implant evaluation.[7]

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http://dx.doi.org/10.1067/j.cpradiol.2015.12.001
0363-0188/

Technique

There is a large variation in breast MRI techniques and protocols among different facilities and institutions despite it becoming a more widely used imaging modality. Such variation has resulted in vast differences in imaging quality, which in turn affects interpretation.[1] The recent BI-RADS fifth edition tries to address this problem by including a new technique section that was not present in prior editions. It gives recommendations for imaging acquisitions and sequences, using a dedicated breast coil, and contrast administration, which are all important for obtaining high-quality breast MRI images for interpretation. The importance of high-quality imaging cannot be stressed enough for accurate interpretation.

Amount of Fibroglandular Tissue

Breast density assessment has gained much interest and attention owing to recent breast density reporting laws, mandating informing patients with dense breast tissue on mammography of the reduced sensitivity of mammography, and the potential for associations with breast cancer risk.[8] The new fifth edition of BI-RADS now includes reporting of breast density for MRI. There are 4 categories as in mammography, which are almost entirely fat, scattered fibroglandular tissue, heterogeneous fibroglandular tissue, and extreme fibroglandular tissue.

Background Parenchymal Enhancement

Reporting of the background parenchymal enhancement (BPE) was introduced in the BI-RADS fourth edition and remains an important part of the MRI reporting in the BI-RADS fifth edition. There are 4 categories, which are minimal, mild, moderate, and marked. There is no direct correlation between mammographic breast density and BPE, although patients with dense breast tissue on mammography have been shown to have increased BPE compared with women with fatty or scattered fibroglandular breast density.[9–11]

BPE is often diffuse and symmetric, but it can be asymmetric and focal. The BI-RADS fifth edition now includes symmetric and asymmetric BPE, which was previously a part of the nonmass enhancement (NME) category. BPE tends to be higher in premenopausal women, pregnant or lactating women, and lower in patients on anti-estrogen therapy. Although the extent of BPE may not have a significant effect on cancer detection, higher BPE can be challenging for the interpreting radiologist. Therefore, the BI-RADS atlas recommends that breast MRI be performed early in a woman's menstrual cycle for elective MRI, such as high-risk screening, in order to decrease BPE in premenopausal patients. Some facilities image during days 7-10 of the menstrual cycle.[7]

Morphologic Assessment

MRI lesion assessment can be divided into enhancing lesions and nonenhancing lesions. Of the enhancing lesions, findings are subdivided into focus, mass, and NME.

Focus

A focus is an enhancing lesion, that is $<$ 5 mm in size and is too small to be characterized. The fourth edition of BI-RADS included foci in addition to focus as part of the enhancing lesion lexicon. However, foci has been eliminated in the new BI-RADS fifth edition as multiple foci, dots of enhancement that are widely separated by intervening normal breast parenchyma that does not enhance, are now considered a pattern of BPE.

Masses

A mass is a 3-dimensional, space-occupying lesion $>$ 5 mm in size, with shape, margin, and internal enhancement characteristics. Shape descriptors for masses are oval, round, and irregular (Fig 1). Lobulated as a mass descriptor has been removed from the lexicon, and a mass with three gentle lobulations or less is now described as oval.

Margin descriptors for masses can be largely divided into 2 categories: circumscribed and not circumscribed. Not circumscribed margin descriptors are irregular and spiculated (Fig 1). Smooth as a margin descriptor has been eliminated from the lexicon.

Internal enhancement characteristics for masses are homogeneous enhancement, heterogeneous enhancement, rim enhancement, and dark internal septations (Fig 2). A homogeneously enhancing mass refers to a uniformly enhancing mass as opposed to a heterogeneously enhancing mass as a nonuniformly enhancing mass with variable internal enhancement. Rim enhancement refers to a predominantly peripherally enhancing mass. The dark internal septation descriptor is used when there is a nonenhancing septation within an enhancing mass. Dark internal septations are often seen in fibroadenomas, which are often oval in shape and hyperintense on T2-weighted images. Such findings should be carefully correlated with mammography and ultrasonography as these findings can also be seen in malignancy.[12] Prior descriptors of enhancing internal septations and central enhancement were considered to be underutilized and were eliminated.

Nonmass Enhancement

NME refers to an enhancing abnormality that is separate from BPE but lacks a 3-dimensional volume, shape, or margin—it lacks characteristics to be described as a mass. The current lexicon has been slightly altered from prior non–masslike enhancement.

Distribution descriptors for NME are similar to that of calcification distribution descriptors in mammography and are characterized as focal, linear, segmental, regional, multiple regions, and diffuse (Fig 3). For example, segmental distribution refers to a triangular single duct distribution with its apex pointing toward the nipple, and regional distribution refers to a large area of NME that does not conform to a single duct system. The previous ductal distribution descriptor has been removed.

Internal enhancement patterns of NME are characterized as homogeneous, heterogeneous, clumped, and clustered ring (Fig 4). Homogeneous and heterogeneous internal enhancement patterns of NME are the same as that of masses. Clumped enhancement refers to a beaded enhancement pattern, but it is differentiated from that of the BPE and is without a shape or a margin to be defined as a mass. The clustered ring enhancement pattern is similar to that of rim enhancement for masses, depicting predominantly peripheral enhancement. It is important to be able to recognize the clustered ring enhancement pattern, because it is most often associated with ductal carcinoma in situ.[13–16] Prior terms such as stippled, punctate, reticular, and dendritic enhancement have been removed.