

Magnetic Resonance Imaging–Guided Breast Interventions

Role in Biopsy Targeting and Lumpectomies

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KEYWORDS

- Breast cancer • Needle biopsy • MR imaging guidance • Lumpectomy • Extent of disease
- Tumor ablation • Neoadjuvant chemotherapy

KEY POINTS

- Breast MR imaging is the most sensitive imaging tool of detecting breast cancer and may reveal breast cancer that is occult to physical examination and by conventional imaging modalities (mammography and ultrasound).
- In cases in which a suspicious lesion is detected by MR imaging and no obvious correlative finding is found by other methods, MR imaging–guided tissue sampling is needed to determine the underlying histopathology.
- Studies have shown advantages of breast MR imaging for predicting recurrence-free survival and pathologic complete response over physical examination and conventional imaging.
- Regarding lumpectomy planning, anticipated benefits from higher sensitivity of preoperative MR imaging have not been clearly shown in large studies.

PROBLEM AND CLINICAL PRESENTATIONS

Use of Contrast-Enhanced Breast MR Imaging

Contrast-enhanced breast MR imaging is an important adjunctive modality for screening and diagnosis of breast cancer. MR imaging has been demonstrated as beneficial and used increasingly as an adjunct to mammography¹ in screening in a subset of women at high risk for developing breast cancer because of its high sensitivity and negative predictive value. MR imaging is being used to assess response for neoadjuvant chemotherapy treatment (NACT), detect otherwise occult breast

cancer presenting as metastatic axillary or systemic disease, evaluate extent of disease in patients with newly diagnosed breast cancer, and assess contralateral breast. Additional clinical trials are needed to determine the significance of MR imaging–detected, otherwise occult disease.²

MR Imaging–Guided Tissue Sampling

In cases in which MR imaging alone detects a suspicious lesion (ie, no correlative finding with other methods), MR imaging–guided tissue sampling

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is needed to determine the underlying histopathology.

Margin Status at Breast-Conserving Therapy

The current positive or close margin rate at initial surgery requiring an additional operation with re-excision is estimated to range from 30% to 60%.^{3,4} There is no ideal method for margin evaluation during surgery. However, there are trials in progress on the use of MR imaging guidance and MR imaging evaluation of the margins intraoperatively with the goal of reducing the need for additional operations.⁵

NEED FOR MR IMAGING-GUIDED PROCEDURES

Recommendations for performance of breast MR imaging are conditioned on a standard level of quality of MR imaging studies with high spatial resolution images. The American College of Radiology accreditation process includes the requirement for facilities to have the ability to provide MR imaging-guided biopsy when offering breast MR imaging.⁶

When a suspicious lesion has been detected by breast MR imaging, and biopsy for histologic diagnosis is suggested, the first step should be to evaluate the area by mammography and targeted ultrasound (US) for a possible correlate.⁷ US guidance is preferred over MR imaging for biopsy if a sonographic correlate can be identified.⁷ US is readily available and US-guided biopsies are quicker, more comfortable for the patient, do not require intravenous contrast, and are less expensive. A US correlate can be identified in approximately half of the cases.^{7,8} If the findings of this approach are unrevealing or uncertain, an MR imaging-guided biopsy should be performed.⁹⁻¹⁵

BREAST MR IMAGING AND TECHNIQUES

There are widespread variations in breast MR imaging techniques, with different approaches to balance morphology, kinetic information, and use of fat saturation versus subtraction techniques. Obtaining good quality breast MR imaging is conditioned on many factors: use of a high-field-strength magnet and a dedicated breast coil, appropriate breast positioning, injection of gadolinium contrast material, high-spatial-resolution imaging without artifacts, and specified adequate timing of the dynamic sequences.

The following MR imaging equipment specifications and performance must meet all state and federal requirements, and the American College of Radiology practice parameters and technical

standards guidelines including routine quality control should apply.⁶ Field strength: a 1.5- or 3-T magnet has typically been used for breast MR imaging. Positioning: all routine clinical breast MR imaging examinations are performed with the patient in prone position with simultaneous bilateral imaging using a dedicated (bilateral) breast MR imaging coil containing two individual depressions for the left and right breast. Prone positioning helps to move the breasts away from the chest wall and minimizes respiratory and cardiac motion effects.¹⁶ Resolution, contrast, and artifacts: the slice thickness should be 3 mm or less; in-plane pixel resolution should be 1 mm or less so as to reduce the problem of volume averaging and to detect and characterize small abnormalities. Chemical fat suppression is helpful as a method for reducing the fat signal. Subtraction imaging for assessment of enhancement and fat suppression are recommended. Misregistration caused by patient motion can occur, and motion correction may aid in reducing artifacts encountered with image subtraction. Contrast: gadolinium intravenous contrast is needed in the evaluation of breast cancer. Dynamic kinetic information based on enhancement data at appropriate time intervals is extremely important for lesion classification.

CHALLENGES IN MR IMAGING-GUIDED BREAST BIOPSY TARGETING

Many of the challenges experienced with MR imaging-guided biopsy are similar to those encountered using stereotactic biopsy with patients prone on a dedicated table and are related to targeting (ie, difficulty with posterior targets or those that are superficial), positioning, and compression (eg, an accordion effect at clip deployment or problems with very dense breasts). Furthermore with MR imaging-guidance, the patient needs to be removed from the magnet to be repositioned for the biopsy to be performed, because there is somewhat limited access to the medial and posterior breast. Additional difficulties may arise, including contrast washout, lesion location-related problems, and/or limitations in confirming lesion sampling.^{9,17}

Cancellation of the procedure is frequent (reported as between 8% and 13%).¹⁸ Nonvisualization of the suspicious finding may be caused by change in tissue enhancement because the patient is in different phase of her period and/or may be related to compression of breast tissue with decreased inflow of contrast material.

Signal-void artifact from needles, obturators, and wires used in the MR imaging setting and hemorrhage (hyperintense on T1 sequences) may obscure the target. Air entered or generated from

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