The role of MRI in breast imaging

Virginia M. Herrmann, MD,1 and A. Joseph Borelli, Jr., MD2
1 Curtis and Elizabeth Anderson Cancer Institute, Savannah, GA, and 2 MRI at Belfair, Bluffton, SC

Magnetic resonance imaging (MRI) of the breast is now recognized as an effective modality in evaluating specific groups of patients with breast lesions or breast cancer and patients suspected of having hereditary BRCA1/BRCA2 mutations. Sensitivity of MRI in detecting breast cancer is high (88%–100%) and exceeds that of mammography and ultrasonography in detecting lesions in patients with occult disease. The specific applications of breast MRI range from detecting tumors in women with breast implants to monitoring response to neoadjuvant chemotherapy. In addition, a growing number of institutions are offering MRI-guided biopsy. Still, breast MRI is not a substitute for routine screening mammography, and results need to be interpreted carefully in conjunction with mammography and ultrasonography.

There is a broad consensus, based on large, randomized trials, that mammography is effective in detecting breast cancer and reducing breast cancer mortality.1,2 Randomized clinical trials and evaluation of community-based screening demonstrate that mammography is beneficial and detects breast cancer earlier in women who are screened regularly.3,4

Despite widespread recommendations for mammography, however, there are considerable concerns about known deficiencies in mammography and its cost-effectiveness as a screening modality.5 The sensitivity of mammography is documented to be 85%–90% but can be as low as 70%, particularly in patients with very dense breasts.6

Magnetic resonance imaging (MRI) has gained increasing popularity as a breast-imaging modality. Dedicated radiofrequency coils specifically designed for the breast and gadolinium contrast materials have helped make MRI an effective and usable tool for breast imaging. The sensitivity of MRI in detecting breast cancer is high (88%–100%). Although this modality does not detect every carcinoma of the breast, MRI of the breast is twice as sensitive and three times more specific than mammography in detecting breast cancers that are radiologically and clinically occult. However, the costliness of MRI and insufficient data supporting MRI as a breast-screening modality have limited its use in the community setting. Additionally, the high false-positive rate of breast MRI has made many clinicians reluctant to use this technology because of past difficulties in interpreting the results.

Today, the widespread availability of excellent image quality from vendors of MRI equipment, recent advances in MRI kinetics that improve specificity, and increasing experience in breast MRI interpretation have expanded the indications and utility of MRI as a modality for breast imaging.

**KEY POINTS**

- Breast MRI is twice as sensitive and three times more specific than mammography in detecting occult breast tumors.
- The technology is increasingly recommended before, during, and after neoadjuvant chemotherapy to evaluate tumor response.
- MRI is especially recommended in following high-risk patients with suspected or confirmed BRCA mutations.
- MRI-guided needle localization and core biopsy are offered by a growing number of institutions.
- Breast MRI is not a substitute for screening mammography and is not indicated for the majority of women who are asymptomatic.
Current indications

The American College of Radiology (ACR) states that “screening MRI is not recommended at the current time in the general population of asymptomatic women.” Nonetheless, the ACR and the Working Groups on Breast MRI have determined appropriate applications for breast MRI.7,8

Lesion characterization

Breast MRI has been recognized for some time as ideal for evaluating patients with silicone implants. More recently, MRI has been increasingly recommended to evaluate patients when the results of more conventional breast-imaging techniques (mammography and ultrasonography) are inconclusive. MRI is also helpful in distinguishing between postoperative scarring and recurrent cancer in patients who have undergone breast-conservation therapy.

Neoadjuvant chemotherapy

Breast MRI is increasingly recommended before, during, and after neoadjuvant chemotherapy to evaluate and quantify the tumor response and to determine the extent of residual disease before operative intervention. MRI-compatible tissue markers can be placed at the start of neoadjuvant chemotherapy to localize the tumor area, which is crucial for patients who desire breast conservation and have a complete response to neoadjuvant therapy.

Infiltrating lobular carcinoma

Invasive lobular carcinoma constitutes only 10%–14% of all breast cancers, but it is more likely than ductal cancer to be multicentric and has a higher incidence of synchronous contralateral disease. Usual screening methods—including physical examination, mammography, and ultrasonography—are limited in their ability to detect lobular carcinoma and frequently underestimate the extent of disease. The sensitivity of detecting invasive lobular cancer is as low as 57%–76% for mammography and 25%–87% for ultrasonography.

Studies have documented the effectiveness of MRI in detecting unsuspected disease in the contralateral breast, as well as additional cancers in the ipsilateral breast.9 MRI scanning is currently indicated for evaluating the extent of disease, as well as multifocal or multicentric lobular carcinoma.

Infiltrating ductal carcinoma

In many patients, breast MRI is more accurate than mammography in determining the extent of disease. This increased accuracy allows more appropriate treatment planning in patients who desire breast conservation.10–12

Contralateral breast examination

Contralateral breast cancer has been detected in 6%–7% of patients with a known breast cancer. Breast MRI may be indicated to detect contralateral disease that is undiagnosed by mammography or clinical examination.

Axillary adenopathy with an unknown primary

Patients who are diagnosed with cancer in the axillary nodes and no known primary cancer present a clinical challenge. Breast MRI may identify a primary breast cancer that is mammographically and clinically occult (Figure 1). Similarly, breast MRI may exclude the breast as a primary site and obviate the need for mastectomy.13

Postoperative tissue reconstruction

MRI scanning is helpful in evaluating patients who have undergone tissue transfer flaps for breast reconstruction, such as latissimus or rectus (TRAM) flaps, for recurrent disease.

Silicone and non-silicone breast implants

MRI scanning has been used for some time to evaluate implant integrity. More recently, MRI scanning has been used to detect malignancy in those patients where mammography is difficult or limited due to the presence of implants.

Chest-wall invasion

MRI scanning is indicated prior to anticipated mastectomy or breast-conservation surgery (lumpectomy) in patients whose tumors lie close to the chest wall to determine tumor extension to the pectoralis or rectus fascia or more extensive chest-wall involvement.

Post lumpectomy

Positive or close margins following lumpectomy generally prompt re-excision or mastectomy. Breast MRI is helpful in evaluating the extent of disease at the known site, as well as unsuspected disease in the same or other quadrants.
of the breast. This information is crucial in the decision to re-excite the breast or proceed to mastectomy.

Surveillance of high-risk patients

Significant advances have been made in identifying women at high risk for developing breast cancer. The discovery of the *BRCA1* and *BRCA2* genes and the availability of blood tests for mutations in these genes allow the identification of women with hereditary disease who have a high lifetime risk of breast cancer.

A number of studies have documented the efficacy of MRI in detecting breast cancer and its greater sensitivity than mammography and ultrasonography in patients with hereditary disease. MRI is often recommended to evaluate patients who are suspected of being at risk for hereditary disease, even in the absence of confirmed genetic testing.14

Ductal carcinoma in situ

The role of MRI in detecting ductal carcinoma in situ (DCIS) is emerging. Mammography has high sensitivity but low specificity for detecting DCIS. Breast MRI has been used to evaluate DCIS with varying results. Sensitivity for detection of DCIS reportedly ranges between 45% and 100%. A recent study using high-resolution techniques for detecting DCIS demonstrated significantly greater sensitivity for breast MRI (88%) than for mammography (27%), suggesting a greater role for MRI in the management of known or suspected DCIS.15 However, continued studies and research are needed to improve our ability to detect and interpret DCIS with MRI.16

MRI-guided biopsy

MRI-guided biopsy and needle localization are currently available at some institutions. The need for this capability is highlighted when a suspicious lesion is detected by MRI but was missed on clinical examination, mammography, or ultrasonography. A number of devices are available today for MRI-guided core biopsy of breast tissue. Vacuum-assisted large-core biopsy with MRI is also available but not yet approved for excisional removal of breast cancer.

Institutions where breast MRI is offered should work diligently to provide MRI biopsy and localization capability or affiliate with institutions that offer breast MRI-guided biopsy. As more experience is gained with this technology and its availability becomes more widespread, the capability to perform MRI-guided localizations and core biopsies will become essential in the evaluation and treatment of patients with breast lesions.

Conclusion

Although the indications for breast MRI have increased—and its utility in breast cancer detection and treatment planning is undisputed—it must be emphasized that routine MRI screening is not recommended in the general population of women who are asymptomatic.

Breast MRI is not a substitute for screening mammography. MRI data should be interpreted in conjunction with current mammograms and ultrasoundograms for optimal results. Breast MRI is highly sensitive (88%–100%) and often detects abnormalities that escape detection during clinical breast examination or mammography. These lesions may or may not be clinically significant. Therefore, careful interpretation by experienced clinicians is essential for treatment planning and prior to making recommendations to patients.

References


ABOUT THE AUTHORS

Affiliations: Dr. Herrmann is Professor of Surgery, Mercer University School of Medicine, and a member of the Center for Breast Care, Curtis and Elizabeth Anderson Cancer Institute, Memorial Health University Medical Center, Savannah, GA. Dr. Borelli is President and Medical Director, MRI at Beverly, Bluffton, SC. Conflicts of interest: None disclosed.