How Does MR Imaging Help Care for the Breast Cancer Patient? Perspective of a Medical Oncologist

Akshara S. Raghavendra, MD, MS, Debu Tripathy, MD*

KEYWORDS

• MR imaging • Staging • Breast cancer • Neoadjuvant chemotherapy • Metastatic

KEY POINTS

- MR imaging can detect occult breast cancers and nodes that are not apparent during mammographic, ultrasound, or clinical workup, which may affect treatment outcome.
- MR imaging is often used to characterize extent of disease and monitor clinical response to neoadjuvant systemic therapy, to guide surgical planning; it holds the potential to predict pathologic response.
- MR imaging assists in early staging for treatment planning, as well as staging in (advanced) metastatic disease.

INTRODUCTION

MR imaging has demonstrated superior sensitivity for invasive and in situ cancer detection,[1–6] as well as more accurate determination of disease extent, when compared with physical examination, mammography, and ultrasound.[7,8] Hence, it is now recognized as an important adjunct imaging modality in the evaluation of patients with newly diagnosed breast cancer. The American College of Radiology guidelines for the performance of MR imaging[9] related to breast cancer imaging include evaluation of extent of disease for a known cancer, screening of high-risk patients, screening of the contralateral breast for patients with a new breast malignancy, and assessing response to neoadjuvant chemotherapy (NAC). However, its use has not clearly been linked to improved outcomes in all these situations and, therefore, variations in practice exist. This article reviews the role of MR imaging from the perspective of a medical oncologist, including its ability to diagnose earlier stage disease, assessment of preoperative extent of disease in patients with newly diagnosed breast cancer, and monitoring of response to NAC, as well as its application in specific clinical scenarios among metastatic subpopulations.

By allowing for earlier detection, use of MR imaging may result in diagnosis at an earlier stage and fewer patients requiring systemic therapy, particularly chemotherapy. Simultaneously, staging with MR imaging may upstage patients and identify those who may need more aggressive systemic therapy. With regard to breast cancer survival, it has been proven that NAC is as effective as adjuvant (postoperative) chemotherapy in lowering recurrence and mortality; however, it

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Department of Breast Medical Oncology, Division of Cancer Medicine, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Boulevard, Houston, TX 77030, USA

* Corresponding author. Department of Breast Medical Oncology, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Boulevard, Unit 1354, Houston, TX 77030.

E-mail address: dtripathy@mdanderson.org

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can also enable breast-conserving surgery and less aggressive lymph node excision.[10] The biological heterogeneity of breast cancer, however, results in variable responses to NAC. Ongoing trials are attempting to use response and MR imaging parameter changes over time to personalize therapy and accelerate drug development.[11]

Detection of Additional Disease in the Newly Diagnosed Patient with Breast Cancer

Evidence from 19 studies, reviewed in a meta-analysis by Houssami and colleagues,[12] showed MR imaging had a higher sensitivity for the detection of multifocal or multicentric breast cancer than conventional imaging. MR imaging identified additional foci in 16% of subjects (previously published individual studies reported a range of 6%–34%[13]), resulting in surgical decision change from wide local excision to mastectomy in 8.1% of women and a larger local excision in 11.3% of women.[12] Similarly, in another meta-analysis, MR imaging detected additional foci in 20% of subjects.[14] In the contralateral breast, MR imaging has been reported to detect additional synchronous cancers in 4.1% of subjects, with 65% of the cancer being invasive.[15]

Although extensive data exist regarding the use of MR imaging in detecting multifocal and multicentric disease, there is much controversy in the analysis of treatment outcomes differences as a result of MR imaging.[14] Hence, the true clinical contribution of breast MR imaging in this setting remains ambiguous and needs further studies.

Tumor Vascularity and Ductal Carcinoma In Situ in Upstaging Disease

Because breast cancers rely on neoangiogenesis and on the development of blood microvessels for their growth, increased vascularity in the whole ipsilateral breast may indicate the presence of disease.[16] During the past 10 years, several studies have evaluated the association between asymmetric increased breast vascularity (AIBV) on MR imaging and ipsilateral breast cancer.[16] Ipsilateral AIBV was associated with a more aggressive clinical, pathologic, and molecular profile.[16] This may be interpreted as the consequence of more proangiogenic signals released by highly proliferating cancers.[16] MR imaging is reliable for the analysis of whole breast vascularity. The assessment of vascular maps and of AIBV could represent an additional information for tumor characterization and treatment planning.[16] One study showed that with the use of MR imaging in patients with a preoperative diagnosis of ductal carcinoma in situ (DCIS), the rate of upstaging of DCIS to invasive cancer was 26.7% (35 to 131), emphasizing the role of MR imaging in triaging patients who are at highest risk for occult invasive disease.[17]

Breast Cancer Subtypes

Breast cancer subtypes based on hormone and human epidermal growth factor receptor 2 (HER2) status are used for medical treatment decision. More recent classifications based on gene expression or mutational profiles are being investigated. In a trial conducted by the Translational Breast Cancer Research Consortium, MR imaging detected breast cancer with an overall accuracy of 74%, varying among molecular subtypes.[18] Dynamic contrast-enhanced (DCE)–MR imaging has the ability to depict the physiologic tissue characteristics as a whole tumor and has strong potential use in the management of breast cancer.[19]

Because of the heterogeneity of tumor in patients with triple-negative breast cancer (TNBC) and their varied response to chemotherapy, a combination of treatment planning is important in prognostication. TNBC has distinctive MR imaging features. It appears as a unifocal mass, whereas HER2-positive tumors may be seen as multiple masses at diagnosis. Therefore, MR imaging may prove more effective in depicting TNBC and HER2-positive tumor subtype.[20]

MR imaging is useful for predicting the likelihood of pathologic complete response (pCR) among tumor subtypes following NAC. In a study of 188 women using MR imaging, analysis of residual disease showed significant associations with change in the diameter of the tumor during NAC for TNBC and HER2-positive tumors.[21] Another extensive study demonstrated the utility of DCE–MR imaging by analyzing the biomarker status among NAC patients who had an increase in pCR rate by 46% in TNBC and 73% in nonluminal-positive or HER2-positive subtypes.[22] Functional imaging, such as DCE–MR imaging, promises great clinical potential in its ability to assign biologically driven therapies based on characteristics such as increased metabolism, proliferation, or vascularity. Prospective trials assessing the benefits imparted from MR imaging–driven treatment decisions will be needed; many are currently in progress.

Predicting Tumor Response

Several studies have evaluated the utility of MR imaging performed for staging breast cancer, as well as predicting clinical or pathologic tumor response, which correlated with a long-term disease-free state and overall survival.[23–31]