Use of MR Imaging With Mammography to Increase Breast Cancer Detection in Dense Breast Tissue

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Breast cancer is one of the most common diseases that indiscriminately affects women of all ages.[1] In 2022, approximately 3 million breast cancer cases were diagnosed worldwide, representing about 13% of all malignancies.[1] This high rate of breast cancer makes routine screening especially important for detecting malignancies in the early stages to reduce mortality and successfully treat the disease with less aggressive therapy.[2] The standard method for breast cancer screening is mammography.[2] However, the diagnostic capabilities of mammography alone are limited, and women with dense breast tissue vs those without will not benefit equally from these screenings. For example, dense breast tissue can mask cancer on traditional mammography, causing cancer to go undetected.[2] Therefore, magnetic resonance (MR) imaging in conjunction with traditional mammography is a more reliable approach to detecting breast cancer when screening the high-risk population of women with dense breast tissue, leading to earlier diagnosis, earlier treatment onset, and lower mortality rates.

Breast Cancer Overview

The 2 most common breast cancer types are invasive ductal carcinoma and invasive lobular carcinoma. Invasive ductal carcinoma is responsible for 80% to 85% of breast cancer cases and is much easier to detect on imaging than is invasive lobular carcinoma, which accounts for 10% to 15% of breast cancer cases. Invasive ductal carcinoma stems from the mammary ducts and gradually forms a mass, whereas invasive lobular carcinoma spreads from the lobules and forms a pattern that creates distinctive borders with an unclear mass, making it more difficult to detect.[3]

Breast cancer can be categorized into 5 stages ranging from 0 to IV. Stage 0 involves the least amount of spreading, whereas stage IV involves the greatest amount. In addition, each stage is designated with a letter or number indicating its severity. Staging is commonly determined by the American Joint Committee on Cancer (AJCC) tumor (T), node (N), metastasis (M) staging system. This organized approach includes breast cancer staging for pathological and clinical instances such as biopsies. The AJCC uses 7 key pieces of information in both staging systems[4]:

- disease class
- ERBB2 (formerly HER2) protein status
- estrogen protein status
- growth size
- progesterone protein status
- proliferation to distant sites
- proliferation to neighboring sites

Risk factors for breast cancer include age of menstrual cycle onset and termination, reproductive history, previous atypical tissue sample, obesity, previous radiation exposure to the breasts, breast tissue composition, and family history of the disease.[5] Moreover, women with a lifetime risk of less than 15% have an average threat of developing breast cancer.[5] The established guidelines of the American Cancer Society (ACS)

recommend high-risk screening for women who are most susceptible to breast cancer and have an estimated lifetime risk of greater than or equal to 20% to 25%.[6] In addition, a genetic predisposition, such as the breast cancer gene variations *BRCA1* and *BRCA2*, is observed in 5% to 10% of breast malignancies; the *BRCA1* and *BRCA2* variations are related to a lifetime risk of 50% to 85% and 45% to 69%, respectively.[5]

Breast Density Overview

Breast density characteristics are evident on mammograms and refer to the fibroglandular and fat composition of breasts. Women's breast composition varies immensely, and densities can range from nondense to extremely dense tissue. The American College of Radiology (ACR) Breast Imaging Reporting and Data System (BIRADS) divides breast density into 4 categories[2]:

- A – predominantly fat (nondense)
- B – dispersed fibroglandular tissue (nondense)
- C – varying densities
- D – immensely dense

Dense breast tissue is common in women aged 40 years and older. Approximately 43% of the population in this age group have dense breast tissue, with 36% having BIRADS category C density and the remaining 7% having category D density. Although common, having dense breast tissue increases the risk of developing breast cancer. Dense breast tissue also can obscure breast cancer on standardized mammograms, making detection more difficult.[2] The overall sensitivity for breast cancer detection using mammography is 79.9%. For BIRADS category A density, detection is almost 100%. However, breast cancer detection is 83.9% for category B density, 72% for category C density, and 50% for category D density.[2] As a result, 50% of breast cancers are missed in this high-risk population.

In addition, women with dense breast tissue have an increased mortality rate.[2] Data from a Dutch screening program showed that women with fatty breast tissue (ie, < 25% density) had a 41% reduction in mortality, whereas women with dense breast tissue (ie, > 25% density) had only a 13% reduction in mortality.[2] Therefore, supplemental breast cancer screening is necessary for this high-risk population. Risk factors affecting breast density include age, menopausal status, genetics, pregnancy, and the use of drugs such as hormone therapy.[4]

Legislation for Breast Density

Legislation has been implemented gradually to address the importance of breast density in patients. In 2009, Connecticut became the first state in the United States to mandate notification about breast tissue density after a patient receives a mammography scan and to require insurance companies to provide medical coverage for additional supplemental screening that might be necessary as a result.[7] Federal legislation soon followed. The U.S. Congress passed a law in 2019 mandating patients receive notifications regarding their breast density status, and the Food and Drug Administration now requires imaging centers to notify patients of their breast type.[7] The Mammography Quality Standards Act, which went into effect on September 9, 2024, also mandates notification of breast density and requires that patients with dense breast tissue be informed that such tissue can obscure cancer and additional supplemental imaging might provide more sensitive detection.[7]

Recommended Screening Methods for Breast Cancer Detection

The appropriate screening methods for breast cancer detection depend on an individual's risk factors. According to the ACS, women have an average lifetime risk of developing breast cancer if they do not have a personal or strong family history of breast cancer, were not exposed to radiation to the breasts before age 30 years, or do not have breast cancer gene variations such as *BRCA1* and *BRCA2*. Conversely, women are more susceptible to breast cancer if they have a lifetime risk of 20% to 25% or higher due to a strong family history (eg, first-degree relative), a *BRCA* gene variation, or diagnostic or therapeutic radiation exposure to the breasts before age 30 years.[4]

The ACS recommends screening mammography for women with an average lifetime risk of developing breast cancer. The ACS's guideline for women aged 40 to 44 years is an optional annual mammography scan; the guideline for women aged 45 to 54 years is to receive annual screening mammography; and for women aged 55 and above, the guideline is screening mammography every other year, with the option for annual screening.[4]

The ACS also provides screening recommendations for women with an increased risk of developing breast cancer. The ACS recommends these women receive MR imaging in addition to mammography beginning at age 30 years; screening should continue as long as they remain in good health.[4]

Benefits of MR Imaging in Conjunction With Mammography

Although the breast cancer detection rate in mammography is up to 93% in populations with fatty breast tissue, that sensitivity level decreases to less than 30% in the high-risk population of women with extremely dense breast tissue.[7] The ACR recommends supplemental breast cancer screening, such as MR imaging, based on individual risk factors.[7] MR imaging is considered the most sensitive method for detecting breast cancer in the high-risk population of women with dense breast tissue.[5] A meta-analysis conducted by Upadhyay and Wolska found that in the ECOG-ACRIN 1141 trial the dynamic contrast-enhanced abbreviated MR imaging protocol was more sensitive than was mammography at detecting ductal carcinoma in situ, with outcomes of 95.7% and 39.1%, respectively.[8] In addition, the meta-analysis found that in high-risk screening the cancer detection rate was significantly higher when MR imaging was used as a supplemental modality with mammography, with a 83% cancer detection rate for dense breast tissue compared with 78% for nondense tissue.[8]

Thus, the benefits of using MR imaging in conjunction with mammography include the increased sensitivity level for detecting breast cancer in women with dense breast tissue. Although mammography is more effective at detecting calcifications and cancer in less dense breast tissue, MR imaging has shown to be significantly more effective at detecting breast cancer in women with dense breast tissue.[8]

Barriers to MR Imaging

Although MR imaging can benefit women with dense breast tissue, challenges related to the more widescale implementation of such imaging exist such as limited availability, cost constraints, patient intolerance to longer scan times (ie, average of 20 to 30 minutes), and need for intravenous contrast agents.[6] In addition, some people are unable to tolerate the enclosed space of the MR imaging system without premedication, conscious sedation, or anesthesia due to claustrophobia.

Conclusion

Detecting breast cancer at the earliest possible stage is important. This is especially true for women with risk factors that can mask the disease such as dense breast tissue. However, breast cancer screening needs a more individualized approach because standardized mammography does not equally benefit all women. Future legislation should provide guidance and medical coverage to encourage high-risk populations of women to seek additional supplemental imaging after screening mammography. For example, MR imaging in conjunction with mammography can help increase breast cancer detection sensitivity for women with dense breast tissue. Although abbreviated MR imaging protocols can help decrease the length and cost of such an examination, women with claustrophobia might still be reluctant to pursue this imaging modality.

As technology continues to advance at a rapid pace, MR imaging likely will become a much more efficient and desired breast cancer screening tool. In addition, continued advances in artificial intelligence might offer more contributions to the radiologic sciences. Further research on the use of MR imaging with mammography for women with dense breast tissue is highly encouraged to reassess potential benefits and provide future insight.

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