An Abbreviated Protocol for High-Risk Screening Breast MRI Saves Time and Resources

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Abstract

Purpose: To review the ability of an abbreviated, high-risk, screening, breast MRI protocol to detect cancer and save resources.

Methods: High-risk screening breast MR images were reviewed, from both an abbreviated protocol and a full diagnostic protocol. Differences in cancer detection, scanner utilization, interpretation times, and need for additional imaging were recorded in an integrated data form, and reviewed and compared.

Results: A total of 568 MRI cases were reviewed, with the abbreviated and full protocols. No difference was found in the number of cancers detected. Scan times were decreased by 18.8 minutes per case, for a total of 10,678 minutes (178 hours). Interpretation time, on average, was 1.55 minutes for the abbreviated protocol, compared with 6.43 minutes for the full protocol. Review of the full protocol led to a significant change in the final BI-RADS® assessment in 12 of 568 (2.1%) cases.

Conclusions: Abbreviated MRI is as effective as full-protocol MRI for demonstration of cancers in the high-risk screening setting, with only 12 (2.1 %) cases recommended for additional MRI evaluation. The efficiency and resource savings of an abbreviated protocol would be significant, and would allow for opportunities to provide MRI for additional patients, as well as improved radiologist time management and workflow, with the potential to add real-time MRI interpretation or double reading.

Key Words: Breast imaging, breast MRI, breast cancer, high-risk screening

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INTRODUCTION

Breast cancer is the leading cancer diagnosis in women in the United States, and the second leading cause of cancer deaths, surpassed by only lung cancer. More than 240,000 breast cancers will be diagnosed in 2015, and almost 40,000 deaths will be caused by breast cancer. The use of screening mammography has led to a 15%-30% decrease in mortality since the 1990s; the mortality rate was unchanged for the 50 years preceding the 1990s [1]. Although mammography provides benefits relating to earlier cancer detection, the sensitivity is not ideal, especially in women with dense breast tissue, in whom sensitivity can be as low as 30%-48% [2-12]. Screening mammography detects approximately 2-4 cancers per 1,000 asymptomatic women.

In high-risk women, additional imaging tools can be used to supplement mammography. High-risk women can be defined by the ACR Appropriateness Criteria®: women with a BRCA gene mutation and their untested first-degree relatives; women with a history of chest irradiation between ages 10 and 30 years; women with genetic syndromes known to increase the risk of breast cancer (eg, Li-Fraumeni syndrome); women with an estimated 20% or greater lifetime risk of breast cancer based on family history; personal history of breast cancer; atypia; and combinations of these characteristics.

These supplemental tools include screening, whole-breast ultrasound, bilateral MRI, and molecular breast imaging (MBI). These tools have been assessed [13-15],

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and each has limitations and benefits. For example, screening breast ultrasound detects approximately 3 of 1,000 additional cancers, in high- and average-risk women, when it is used as a supplement to mammography, yet the specificity is low, as reflected in positive predictive values (PPV) of 9%. In comparison, high-risk screening breast MRI has shown cancer detection rates of 18 of 1,000, and a PPV of 30%, consistent with superior performance [16]. Mammography and ultrasound provide only anatomic information, whereas MRI with intravenous contrast adds functional information related to neovascularity in cancers. In addition, MBI assesses breast cancers based on function, with early data showing performance similar to MRI, but with significant breast and total body radiation [17-23].

Mammography is limited by the masking effect of dense breast tissue, as well as false positives caused by overlapping tissue. Digital breast tomosynthesis or three-dimensional (3-D) mammography begins to overcome this limitation, diagnosing more cancers overall, and as a particular advantage, mainly invasive cancers, while reducing false-positive examinations [24,25]. MRI detects more cancers than 3-D mammography: 18 of 1,000 versus 5-7 of 1,000 [16]. This evidence supports use of MRI as a screening tool in high-risk women.

Typically, MRI is performed with a full or diagnostic protocol with multiple sequences after administration of intravenous contrast material. This examination is detailed, producing approximately 1,200 images for interpretation. Patients spend approximately 40 minutes in the MRI scanning room, which includes 20-30 minutes of scanning time. Decreasing scanning time with an abbreviated MRI protocol may achieve the same high level of cancer detection while providing greater efficiency, improved patient tolerance of the examination, and substantial resource savings.

METHODS

This study was approved by the institutional review board and is HIPAA compliant. From December 16, 2013 to May 19, 2015, high-risk, screening breast MRIs were interpreted by breast imaging specialists who had an average of 10.4 years of experience (range: 1-22 years). Interpretations were performed in two review stages of the following: (1) the first subtraction series and the maximum-intensity projection (MIP) from that series ("abbreviated protocol"); and (2) all sequences ("full protocol").

The full MRI protocol was as follows: (1) bilateral axial T1-weighted gradient echo; short tau inversion recovery (STIR); diffusion-weighted apparent diffusion coefficient, precontrast fat-saturated T1; dynamic post-contrast fat-saturated T1 at three time points with subtractions performed; delayed fat-saturated T1 postcontrast; and an MIP from the first subtraction series. The abbreviated protocol was as follows: (1) bilateral axial precontrast fat-saturated T1; and (2) one postcontrast fat-saturated T1, with a subtraction and MIP performed (Fig. 1a, b). After initial review of the abbreviated MRI images, a clinically integrated electronic form designed to collect data, was completed, including patient age, risk factors, and a BI-RADS assessment.

After review of the full study, additional questions were asked on the MachForm, to identify whether the full protocol led to a change in study interpretation. Details about the findings, including which ones led to a change, and differences in BI-RADS assessment, were collected. These data were transferred to an Excel spreadsheet (Microsoft, Redmond, Washington) for review. Statistical analysis was performed using a paired *t* test.

The number of high-risk screening examinations was determined by review of the indication for breast MRIs performed during the study period, using the radiology information system. These cases were compared with the recorded cases in the MachForms, to include all known screening cases. The interpretation time was observed and recorded for representative examples of the abbreviated and full protocols. The time recorded did not include any of the following: time to review history, comparison mammograms, or ultrasounds; image-loading time in PACS; or time to report the case, as this was the same for both protocols. The difference in interpretation time for the abbreviated versus full protocol was calculated.

RESULTS

A total of 1,181 breast MRIs, in 1,052 women, were performed and read by breast imagers, from December 16, 2013 to May 19, 2015. Of these, 568 (48.1%) cases, in 505 women, were high-risk screening and were entered into the MachForm database. The average age of the 505 women was 53.2 years (range: 24-81 years). Review of the full protocol led to a significant change in the final BI-RADS assessment in 12 of 568 (2.1%) cases.

All cancers were visible on the abbreviated protocol. Seven cancers were detected: 5 were invasive (4 of grade 2; 1 of grade 1); 2 were ductal carcinoma in situ (1 was grade 1; 1 was grade 3; Figs. 2a-c, 3a, b). A total of 29 (5.1%) biopsies were recommended. The cancer detection rate was 12.3 of 1,000.