Early Uptake of Breast Magnetic Resonance Imaging in a Community-Based Medical Practice, 2000–2004

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Abstract

Background: Clinical applications of magnetic resonance imaging (MRI) of the breast have expanded across the breast cancer detection and control spectrum over the past decade. Use appears to be growing, although evidence for or against its use is still accumulating.

Methods: Using electronic health plan and medical record data, we documented early trends in breast MRI use from 2000 through 2004 in a large community practice setting with approximately 82,000 eligible female patients. During the study period, 225 women received at least one breast MRI; of those, 64 had subsequent MRI (for a total of 333 MRIs).

Results: Utilization grew from 6 MRIs in 2000 to 112 in 2004, with increasing use for screening, diagnosis, disease staging/treatment, and surveillance purposes. Diagnostic use accounted for nearly half of the breast MRIs (164 of 333). In this community-based practice, there was rapid uptake of this new technology despite paucity of evidence about its uses.

Conclusions: As new evidence is generated, use of this technology will need to be monitored to minimize the risk of overuse and unintended downstream consequences.

Introduction

MAGNETIC RESONANCE IMAGING (MRI), a noninvasive high-contrast imaging technique, has emerged as a promising tool for breast cancer detection and control. First approved by the U.S. Food and Drug Administration (FDA) as a diagnostic tool in the early 1990s, breast MRI now has additional applications in screening, disease staging and treatment, and breast cancer surveillance. Despite the range of uses, evidence about its effectiveness is still accumulating.^{1,2} Breast MRI was recently recommended as an adjunct screening tool for women at very high risk for breast cancer.³ Use of MRI for diagnostic purposes remains uncertain, in part because of the potential for increased downstream effects and resource use.^{1,2,4} For women with breast cancer, the benefits of breast MRI for assessment of disease stage and extent are still debated,^{5–7} and few studies have evaluated surveillance for disease recurrence.⁸

To our knowledge, no studies have examined the uptake of breast MRI in community settings. As effective uses of this new technology are still being determined, documenting the extent of early use and downstream consequences across the different applications is important. Utilization may be diffi-

cult to rein in as additional evidence about appropriate use becomes available.⁹

Materials and Methods

With medical utilization data from Harvard Pilgrim Health Care (HPHC), a not-for-profit health plan in New England, we identified 225 women who received at least one breast MRI at a large multispecialty community medical practice in the greater Boston area from 2000 through 2004. The practice serves a stable population of approximately 300,000 patients, half of whom were HPHC-insured during the study period. Current procedural terminology codes 76093 (unilateral) and 76094 (bilateral) were used to identify breast MRI procedures among the approximately 82,000 HPHC-insured women aged ≥18 receiving care at the practice. Breast MRIs became available at the medical practice in 2004; earlier MRIs were done at local hospital facilities. A trained abstractor used full-text electronic medical records (EMR) to determine patient characteristics, indications and results for the first MRI, and use of breast imaging up to 2 years before and after the initial MRI. Subsequent breast cancer diagnoses were also collected up to 2 years after the initial MRI.

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TABLE 1. CHARACTERISTICS OF 225 WOMEN AT TIME OF INITIAL BREAST MAGNETIC RESONANCE IMAGING PERFORMED BETWEEN 2000 AND 2004

Characteristics of women at initial MRI ^a	With prior breast cancer (n = 115)	No prior breast cancer (n = 110)		
Age at initial MRI, years				
Mean (SD)	53.2 (9.6)	49.2 (10.0)		
Body mass index				
Mean (SD)	26.7 (0.6)	24.7 (0.5)		
Smoking status, % current or former	36	33		
At least one live birth, %	64	68		
Prior history of breast disease, %	N/A	42		
Family history of breast cancer in 1st degree relative, %	25	30		
Among whom, 1st relative <age 45, %	39	54		
Breast imaging within prior 15 months, %	97	98		
Clinical indications for MRI	Initial MRI	Subsequent MRI	Initial MRI	Subsequent MRI
Screening	N/A	N/A	14	11
Diagnostic	44	12	92	16
Staging/treatment	32	5	N/A	N/A
Surveillance	31	56	N/A	N/A
Other/unknown	8	5	4	3

^aMissing body mass index for 12 women, smoking history for 2 women, prior parity for 7 women, history of breast disease for 5 of the 110 women without breast cancer, complete family history for 12 women, prior imaging for 5 women. All percentages rounded.

MRI, magnetic resonance imaging; N/A, not applicable; SD, standard deviation.

Breast MRIs were categorized as (1) screening, if performed on an asymptomatic woman without previously noted abnormalities or breast cancer, (2) diagnostic, if performed because of abnormalities noted by the woman, clinician, or on imaging in the prior 6 months, (3) staging/treatment, if performed within 6 months of a new breast cancer diagnosis or before completion of initial breast cancer treatment, and (4) surveillance for recurrence, if performed on a woman with prior breast cancer and no new symptoms or findings. Results were classified into the Breast Imaging Reporting and Data System (BIRADS) scheme based on documentation of the findings in the medical record.¹⁰

Results

Over half (51%) of the 225 women had breast cancer before their first breast MRI; half of these cancers were noninvasive. Most women without breast cancer had at least one risk factor and were younger than those with prior breast cancer (49 vs. 53 years, respectively) (Table 1). Sixty-four women had subsequent breast MRIs during the study period, resulting in a total of 333 breast MRIs.

Breast MRI use was rare in 2000 but increased for all indications through 2004, from 6 to 112 (Fig. 1). First reported in 2002, screening breast MRI comprised 8% of the MRIs overall and 18% of those among women without prior breast cancer (Table 1). Diagnostic MRIs were most prevalent, accounting for nearly 50% (164 of 333 MRIs). Among women with breast cancer, staging/treatment accounted for nearly 20%, and surveillance accounted for 45% of the MRIs.

Nearly all women (214 of the 223 with available data) had breast imaging in the 15 months before their initial MRI, and the majority of women (76%) had breast imaging in the 6 months leading up to their initial MRI. The purpose of the

prior imaging was concordant with that of the breast MRI. Among the 136 women whose initial breast MRI was for diagnostic purposes, 78% had diagnostic breast imaging of

FIG. 1. Number of initial and subsequent breast magnetic resonance imaging (MRI) by clinical indication and calendar year, 2000–2004. Shown are frequencies of clinical indications for 313 of the 333 breast MRIs where indication could be determined. Breast MRI indications were defined as (1) screening, if performed on an asymptomatic woman without previously noted abnormalities and without prior breast cancer, (2) diagnostic, if performed because of abnormalities noted by the woman, clinician, or imaging performed in the prior 6 months, (3) staging/treatment, if performed within 6 months of a new breast cancer diagnosis or before completion of initial breast cancer treatment, and (4) surveillance for recurrence, if performed on a woman with prior breast cancer diagnosis and no new symptoms or findings. In our community setting, breast MRI use has increased over time for all indications.

mammography or ultrasound, whereas women whose initial MRI was for screening or surveillance were more likely to have had breast imaging for screening or surveillance in the prior 6 months.

Of the 225 initial breast MRIs for which follow-up results were collected, 61% were coded as negative or benign (BIRADS 1 and 2) and 19% were coded as probably benign with 6 month short-term follow-up advised (BIRADS 3). Of the women with MRIs coded as BIRADS 1–3, 101 (45%) had additional imaging within 6 months. Imaging included ultrasounds (54%), MRIs (45%), screening or surveillance mammograms (31%), and diagnostic mammograms (25%). Among the 26 women whose initial MRIs results were coded as indeterminate (BIRADS 0) or suspicious (BIRADS 4 or higher), 8 (31%) received additional imaging within 6 months. Biopsies were performed on 31 women within 2 months and 45 women within 6 months of their initial MRI. The majority of the women who had either imaging or biopsy follow-up within 2 months had an initial MRI result of BIRADS 1, 2, or 3, suggesting that MRI may not have altered clinical management. Within 12 months, 2 women who had diagnostic MRIs were diagnosed with invasive breast cancer and 4 with ductal carcinoma *in situ*. No cases of invasive or *in situ* cancers were diagnosed within 12 months after a screening or surveillance MRI.

Discussion

We found that breast MRI use in a large community practice was rare in 2000 but increased rapidly by 2004 across a range of indications. From the population of approximately 82,000 women, 225 women had at least one breast MRI during the 5-year study period, and 64 (28%) had multiple MRIs. Although the majority (80%) of the initial MRIs were negative or probably benign, nearly half of the women had additional breast imaging. Our study was limited to one medical practice; thus, the findings may not be generalizable.

Prior research demonstrates a positive relationship between availability of new imaging technologies and their use, including potential overuse.¹¹ Nearly 75% of breast imaging practices in the United States now report having breast MRI machines¹²; >60% now report availability for screening, compared with only 12% in 2003.^{12,13} With the use of MRI in general tripling over the past decade,¹⁴ we found that breast MRI use also increased dramatically in the early part of the decade. Our study, conducted in a community-based clinical practice, provides a better understanding of the emergence and application of this technology in nonacademic centers at a time when the available pool of evidence about effectiveness was still small. Diagnostic and surveillance breast MRIs, for which still today there is little consensus on best practices, comprised three fourths of all MRIs performed from 2000 through 2004. With several clinical trials beginning in the early 2000s¹⁵ and little conclusive evidence about effectiveness, screening breast MRI nonetheless emerged as an application in our study population. Like other new technologies, use of breast MRI in the absence of conclusive evidence may lead to a cascade of downstream consequences,¹⁶ such as unnecessary follow-up testing for abnormal or additional findings and more extensive treatment, for example, bilateral mastectomy.¹⁷ As women begin to accept breast MRI as they have mammography screening,¹⁸ it may be difficult to break

the growing trust of this technology. Insurance coverage for the procedure, however, is likely to impact future use. Therefore, prospective assessment of whether and how the uses of breast MRI in community settings have changed over time will be needed, given the growing acceptability of the procedure, the recent recommendations about its use for screening and staging/treatment, and the continually evolving standards for insurance coverage.^{3,19}

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Disclosure Statement

The authors have no conflicts of interest to report.

References

1. DeMartini W, Lehman C, Partridge S. Breast MRI for cancer detection and characterization: A review of evidence-based clinical applications. *Acad Radiol* 2008;15:408–416.
2. Hylton N. Magnetic resonance imaging of the breast: Opportunities to improve breast cancer management. *J Clin Oncol* 2005;23:1678–1684.
3. Saslow D, Boetes C, Burke W, et al. American Cancer Society guidelines for breast screening with MRI as an adjunct to mammography. *CA Cancer J Clin* 2007;57:75–89.
4. Bruening W, Launder J, Pinkney N, Kostinsky H, Schoelles K, Turkelson C. Effectiveness of noninvasive diagnostic tests for breast abnormalities. Comparative effectiveness review No. 2. (Prepared by ECRI Evidence-based Practice Center under Contract No. 290-02-0019.) Rockville, MD: Agency for Healthcare Research and Quality, 2006.
5. Peters NHGM, Borel Rinkes IHM, Zuithoff NPA, Mali WPTM, Moons KGM, Peeters PHM. Meta-analysis of MR imaging in the diagnosis of breast lesions. *Radiology* 2007; 246:116–124.
6. Houssami N, Hayes DF. Review of preoperative magnetic resonance imaging (MRI) in breast cancer: Should MRI be performed on all women with newly diagnosed, early stage breast cancer? *CA Cancer J Clin* 2009;59:290–302.
7. Solin LJ, Orel SG, Hwang W-T, Harris EE, Schnall MD. Relationship of breast magnetic resonance imaging to outcome after breast-conservation treatment with radiation for women with early-stage invasive breast carcinoma or ductal carcinoma *in situ*. *J Clin Oncol* 2008;26:386–391.
8. Gorechlad JW, McCabe EB, Higgins JH, et al. Screening for recurrences in patients treated with breast-conserving surgery: Is there a role for MRI? *Ann Surg Oncol* 2009;15: 1703–1709.
9. Deyo RA. Imaging idolatry: The uneasy intersection of patient satisfaction, quality of care, and overuse. *Arch Intern Med* 2009;169:921–923.

10. Erguvan-Dogan B, Whitman GJ, Kushwaha AC, Phelps MJ, Dempsey PJ. BI-RADS-MRI: A primer. *Am J Roentgenol* 2006;187:W152–160.
11. Baker LC, Atlas SW, Afendulis CC. Expanded use of imaging technology and the challenge of measuring value. *Health Aff* 2008;27:1467–1478.
12. Bassett LW, Dhaliwal SG, Eradat J, et al. National trends and practices in breast MRI. *Am J Roentgenol* 2008;191:332–339.
13. Farria DM, Schmidt ME, Monsees BS, et al. Professional and economic factors affecting access to mammography: A crisis today, or tomorrow? *Cancer* 2005;104:491–498.
14. Smith-Bindman R, Miglioretti DL, Larson EB. Rising use of diagnostic medical imaging in a large integrated health system. *Health Aff* 2008;27:1491–1502.
15. Kriege M, Brekelmans CT, Boetes C, et al. MRI screening for breast cancer in women with familial or genetic predisposition: Design of the Dutch National Study (MRISC). *Fam Cancer* 2001;1:163–168.
16. Deyo RA. Cascade effects of medical technology. *Annu Rev Public Health* 2002;23:23–44.
17. Katipamula R, Degnim AC, Hoskin T, et al. Trends in mastectomy rates at the Mayo Clinic Rochester: Effect of surgical year and preoperative magnetic resonance imaging. *J Clin Oncol* 2009;27:4082–4088.
18. Essink-Bot ML, Rijnsburger AJ, van Dooren S, de Koning HJ, Seynaeve C. Women's acceptance of MRI in breast cancer surveillance because of a familial or genetic predisposition. *Breast* 2006;15:673–676.
19. Lehman CD, Gatsonis C, Kuhl CK, et al. MRI evaluation of the contralateral breast in women with recently diagnosed breast cancer. *N Engl J Med* 2007;356:1295–1303.

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