

Preoperative Staging with Magnetic Resonance Imaging, with Confirmatory Biopsy, Improves Surgical Outcomes in Women with Breast Cancer without Increasing Rates of Mastectomy

Ian Grady MD, FACS,* Heidi Gorsuch-Rafferty MD, FACS,[†]
and Pat Hadley MD, FACR[‡]

*North Valley Breast Clinic, Redding, CA; [†]Rockingham Memorial Hospital, Harrisonburg, VA;

[‡]MD Imaging, Redding, CA

■ **Abstract:** Needle biopsy to evaluate findings on MRI that could alter surgical planning has been recommended. This study is a retrospective review to evaluate MRI preoperative staging with biopsy confirmation of suspicious findings. A total of 184 women were diagnosed with breast cancer between January 2004 and June 2008. Of these, 79 underwent bilateral MRI before definitive surgery and 105 did not. Suspicious findings on MRI, mammography, or clinical exam underwent additional needle biopsy at the discretion of the surgeon. A retrospective chart review was performed to compare the two groups with respect to rates of reoperative surgery, successful breast conservation, and confirmatory biopsies. Sensitivity and specificity of MRI for preoperative staging is 0.81 and 0.84, respectively. There were no significant differences in demographics or cancer characteristics between the MRI and non-MRI groups. Fewer women who underwent preoperative MRI staging required repeat breast surgery (11% versus 26%, $p = .04$) or repeat axillary surgery (10% versus 20%, $p = .05$). There is no difference in the proportion of women who successfully completed conservative therapy and those treated radically (52% versus 53%), but there is a significant increase in women who undergo additional needle biopsy to confirm suspicious findings after initial diagnosis in the MRI group (25% versus 11% $p = .04$). In this study, mastectomy rates are not increased; suggesting that women who undergo mastectomy following staging would undergo mastectomy following failed conservative therapy if they were not staged. The downside of this improvement is a 14% increase in women who require confirmatory biopsy. ■

Key Words: breast neoplasms/diagnosis, breast neoplasms/surgery, magnetic resonance imaging, neoplasm staging, mastectomy

Conservative surgery is currently the treatment-of-choice for early-stage breast cancer. The survival rate of conservative management is equivalent to radical surgery (1,2), but cosmetic and psychological outcomes are better (3,4). However, there are challenges that need to be met to perform conservative surgery successfully. Up to 60% of patients require repeat surgical procedures (5–7) and attempts at conservative therapy can fail when unappreciated, extensive disease necessitates eventual mastectomy, because clear margins cannot be obtained despite multiple re-excisions

Address correspondence and reprint requests to: Ian Grady MD, FACS, North Valley Breast Clinic, 1335 Buenaventura Blvd, Suite 204, Redding, CA 96001, USA, or e-mail: igrady@breastpractice.com.

DOI: 10.1111/j.1524-4741.2012.01227.x

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The Breast Journal, Volume 18 Number 3, 2012 214–218

(5). This can result in an overall higher cost and longer time to remission.

Preoperative staging using contrast-enhanced MRI prior to definitive surgery has been shown to decrease rates of reoperation for positive margins (8,9). MRI has also been shown to detect additional foci of cancer that result in a change in surgical management, (8,10–13) accurately identify patients who are not candidates for conservation (12,14), identify patients with unsuspected contralateral disease (11,15), and possibly reduce recurrence rates following conservative surgery (16).

Conversely, MRI staging has been criticized as possibly leading to unnecessary additional mastectomies (13,17) and not improving recurrence rates (18,19) or survival (19).

This study is a retrospective review to evaluate the effect of preoperative MRI staging on rates of reoperative surgery and rates of breast conservation.

MATERIALS AND METHODS

In an outpatient setting, 189 women were diagnosed with operative breast cancer using a core-needle biopsy technique over a four and a half year period between January 2004 and June 2008. Of these, five either initially refused or did not complete surgical therapy to a negative margin. The remaining 184 did complete surgery to a clear margin.

The two surgeons planned their surgical therapy based on their client's clinical exam and mammographic findings. One of the two surgeons ordered preoperative, bilateral, contrast-enhanced MRI as an aid to surgical planning routinely beginning in late 2004. The other did not begin ordering routine preoperative MRI until late 2007. This practice pattern afforded the opportunity to evaluate retrospectively two groups of women, one having undergone preoperative MRI, and the other group not. Accordingly, this study is a retrospective review of these two groups with regard to operative outcomes.

Each patient in this review was diagnosed using a core-needle biopsy instrument. Additional biopsies were then performed at the discretion of the surgeon to evaluate suspicious areas found on clinical and mammographic studies that would potentially result in a change in the patient's planned therapy. Examples of findings that could change the surgical plan are shown in Table 1. In women who underwent preoperative MRI, the study was performed prior to surgery and suspicious findings were evaluated with vacuum-assisted biopsy (Mammotome, Ethicon Endosurgery, Cincinnati, OH), or in the case of suspicious lymph nodes, FNA or core-needle biopsy at the discretion of

the surgeon. Finally, the patient was taken to surgery. Repeat procedures were performed as needed to obtain clear margins. Both surgeons accepted margins as negative if microscopically clear, but re-operations were occasionally at surgeon discretion. All mammograms were read by MQSA qualified radiologists. The same radiologists interpreted the mammogram and MRI studies. MRI imaging was performed using a GE Signa 1.5 Tesla short-bore MRI (GE Healthcare, Piscataway, NJ) in the prone position using an Invivo 1.5T Biopsy Breast Array Coil - Model BBC (8 channel), (Invivo, Orlando, FL). Images were acquired using the GE vibrant imaging technique for simultaneous bilateral study.

Physiologic (enhancement curve) imaging

Images were obtained before and at 0, 1, 2, 3, 4, 5, and 6 minutes post injection of 20 cm³ gadolinium (Magnevist – Bayer HealthCare Pharmaceuticals, Berkeley, CA). T1 weighted, sagittal images were then obtained with thin sections through areas of interest (2–3 mm), if needed. Enhancement curves were localized using subtraction images. Computer-aided detection was performed with cadstream software (Merge Healthcare, Chicago, IL).

Anatomic imaging

Axial and coronal Short T1 Inversion-Recovery (STIR) images were obtained using the Invivo Biopsy Breast Array Coil, after completion of CAD stream processing to obtain anatomic information for the breast and axilla.

MRI findings considered positive (BI-RADS 4–5)(20,21)

In the breast, MRI findings that were considered suspicious were >100% enhancement, Peak or Plateau-type enhancement with rapid wash-in and wash-out, lesions that were >5 mm in diameter or with malignant type anatomic characteristics (greater than 100% enhancement).

In the axilla, suspicious MRI findings included generalized lymph node enlargement, cortical asymmetry and loss of hilum visible on axial and coronal STIR images.

Statistical Analysis

The significance of means was calculated with the Student's *t*-test using Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA). The confidence

Table 1. Findings on preoperative staging studies that can change a surgical plan

Finding	Definition	Change to Plan
Malignant node	Radiologic N1–N3 nodal disease	Axillary dissection
Disease extension	Tumor >2 cm from the primary	Mastectomy or larger lumpectomy
Multifocality	Tumor in multiple, separate foci	Mastectomy
Contralateral disease	Tumor on the contralateral side	Contralateral resection

intervals for proportions were calculated for the assessment of rates of conservation using the Scores method (22).

RESULTS

This study retrospectively evaluates the effect of preoperative MRI on surgical outcomes in 189 women, ranging in age between 31 and 99, who were diagnosed by a core-needle biopsy technique with operative breast cancer between 1/2004 and 6/2008.

Of these patients, 79 had been evaluated with MRI prior to surgery and 105 had not. These two groups were found to be equivalent with respect to age, menopausal status, breast cancer histology, pathologic stage at diagnosis, and hormone receptor status as shown in Table 2. Approximately 80% of both groups were postmenopausal. Most were estrogen and progesterone receptor positive. One third of the cancers in each group were stage I and one-third stage II. Almost 20% in each group were non-invasive. Less than 10% were stage III.

When compared to surgical pathologic truth, MRI was found to have a sensitivity of 81% and a specificity of 84% in the detection of breast findings that could alter planned conservative therapy (Table 1).

Table 2. Patient Characteristics by Group

	N	MRI performed	MRI not performed
Average age	184	63	64
Premenopausal	39	17 (22%)	22 (21%)
Postmenopausal	145	62 (78%)	83 (79%)
ER positive	129	56 (89%)	73 (88%)
PR positive	111	47 (75%)	64 (77%)
DCIS	37	16 (20%)	21 (20%)
Invasive ductal	127	52 (66%)	75 (71%)
Invasive lobular	20	11 (14%)	9 (9%)
Stage 0	31	14 (18%)	17 (16%)
1	59	26 (33%)	33 (31%)
2	63	25 (32%)	38 (36%)
3	15	4 (5%)	11 (10%)
Unknown ¹	16	10 (13%)	6 (6%)

¹16 patients did not have an axillary staging procedure.

Women who were preoperatively staged showed a statistically significant decrease in the average number of procedures required to obtain clear margins. At least one additional breast surgery to obtain a clear margin was required in 26% of women who did not undergo MRI, whereas only 11% of women who were imaged preoperatively required an extra procedure ($p = .04$). (Table 3).

Similarly, fewer women who underwent MRI staging required repeat axillary procedures. Only 10% of women who underwent MRI staging required a repeat procedure, whereas 20% in the non-staged group required a repeat procedure ($p = .05$). (Table 3).

Rates of mastectomy were not affected by the use of MRI preoperative staging. Overall conservation was successful in 52% of women who were evaluated with MRI and in 53% of those who were not evaluated. (Table 4) No patient who was treated by mastectomy was subsequently discovered to have been treatable conservatively on final pathology.

Although some women in the non-MRI arm underwent additional staging biopsies prior to surgery to evaluate either suspicious mammographic or clinical findings, this was a more common event in women who were staged with MRI. Additional staging biopsies were performed in 11% of women who were not imaged as compared to 25% ($p = .036$). (Table 5).

DISCUSSION

There is currently no consensus in the surgical community regarding the advisability of MRI staging prior to surgery. The areas in which MRI could potentially contribute would include improved operative outcomes and decreased recurrence rates. Since recurrence rates are currently fairly low, the potential effect of MRI would be small in this area. Conversely, rates of reoperation are high and MRI here has the potential to make a positive impact.

Our data shows improved surgical outcomes in women who undergo preoperative staging with MRI.

Table 3. Differences in operative procedures performed with and without MRI preoperative staging

$p = .04$						$p = .05$					
Breast	N	Avg	95% CI	1 Proc	>1 Proc	Axilla	N	Avg	95% CI	1 Proc	>1 Proc
MRI Yes	79	1.13	1.0–1.2	70 (89%)	9 (11%)	MRI Yes	69	1.10	1.0–1.2	62 (90%)	7 (10%)
No	105	1.35	1.3–1.4	78 (74%)	27 (26%)	No	99	1.22	1.1–1.3	79 (80%)	20 (20%)
Difference = 15%						Difference = 10%					

Table 4. Differences in breast conservation with and without MRI preoperative staging

NS			
	N	Avg	95% CI
MRI Yes	41	0.52	0.41–0.63
No	56	0.53	0.44–0.63
Difference = 1%			

Table 5. Differences in additional needle biopsies performed with and without MRI preoperative staging

p = .036					
	N	Avg	95% CI	0 Bx	>0 Bx
MRI Yes	79	0.3	0.2–0.4	59 (75%)	18 (25%)
No	105	0.13	0.06–0.2	93 (89%)	10 (11%)
Difference = 14%					

This study is unique in that it uses surgeon referral as a means of selection among women whose breast cancers are very similar. Of course, any retrospective trial is subject to bias, but we believe that this method of selection has less potential bias than retrospective studies that involve MRI and no MRI groups or studies that use historical controls.

We have been able to demonstrate that MRI leads to decreased returns to the operating room without a corresponding increase in mastectomies. This improvement occurs by eliminating re-operative breast surgery and unnecessary sentinel node biopsies. The latter through preoperative confirmation of node positivity.

We hypothesize that the addition of staging biopsy to confirm MRI findings allows the identification of women who are destined to fail conservative therapy. In other words, women who need mastectomies are identified prior to surgery; not after undergoing one or more surgical excisions. Further, prospective study is needed to evaluate this hypothesis.

The downside of this improvement in outcome is a 14% increase in women who require a needle biopsy procedure to evaluate MRI findings prior to surgery. It is our view that this is a price worth paying. Staging needle biopsies are less expensive, less traumatic, and easier to schedule than a return to the operating room.

Decreased returns to surgery also benefit women who need cytotoxic chemotherapy since multiple

surgical procedures delay lifesaving systemic treatment. We have experienced no significant delays in obtaining MRI studies. Virtually all our patients, who are staged with MRI, proceed from diagnosis to definitive surgery in less than 10 days, even if they need further staging biopsies.

There are limitations to this study. First, it is retrospective. Second, it was performed at a single institution on relatively small numbers of women. Further, prospective evaluation of MRI staging will be required to fully assess the potential of this imaging technique.

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