The American Journal of Surgery (2009) 198, 547–552

The American Journal of Surgery®

The American Society of Breast Surgeons

Does magnetic resonance imaging accurately predict residual disease in breast cancer?

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KEYWORDS:
Breast conservation therapy (BCT);
magnetic resonance imaging (MRI);
re-excision;
Positive margins;
Invasive breast cancer;
Residual disease

Abstract

BACKGROUND: The accuracy of magnetic resonance imaging (MRI) in identifying residual disease after breast conservation therapy (BCT) is unclear.

METHOD: Review of an institutional database identified patients with positive or close (≤2 mm) margins undergoing MRI before re-excision. Histopathologic correlation was performed.

RESULTS: Forty-three women underwent MRI after BCT. MRI suggested residual disease in 29 patients, of whom 20 (69%) had residual carcinoma pathologically. Nine patients had false-positive MRI as seen by benign pathology findings. Fourteen MRIs indicated no residual disease, of which 6 had residual disease pathologically. The sensitivity and positive predictive value of MRI was 77% and 69%, respectively. MRI conducted within 28 days of the original surgery was 85% sensitive. MRI performed after 28 days was 69% sensitive.

CONCLUSIONS: MRI is able to detect residual disease among most patients undergoing re-excision. False-positive results may be caused by inflammatory processes that resemble residual disease.

Magnetic resonance imaging (MRI) has become a useful tool in the diagnostic work-up of breast carcinoma. There are no definitive criteria for MRI evaluation in newly diagnosed breast cancer; although there are criteria for MRI screening in a select group of high-risk patients.[1,2] Commonly used criteria include determination of the extent of disease in women with complex standard imaging (mammography and ultrasound), occult breast cancer in the face of dense breast tissue or pathologically confirmed lymphadenopathy, and suspicion of multifocal/multicentric disease.[3,4] However, these and other indications do not represent strict criteria, and therefore the use of breast MRI often is performed at the surgeon's discretion.

As the technology for breast cancer imaging has improved, so has surgical therapy. Multiple studies have shown that breast conservation therapy (BCT) is equivalent to mastectomy in appropriately selected stage I and II breast cancer patients.[5–7] These trials have shown that there are no significant differences in overall or disease-free survival rates when comparing the two treatments. Proper patient selection includes the verification that negative margins can be obtained while still maintaining a good esthetic result. With or without intraoperative evaluation of margins, the

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Manuscript received March 24, 2009; revised manuscript April 18, 2009

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doi:10.1016/j.amjsurg.2009.04.008

rate of positive margins after lumpectomy is still high.[8,9] Although most BCT patients undergo radiation therapy after surgery, the presence of residual disease or close margins (defined as ≤2 mm) confers an increased risk of local recurrence.[10–13] Therefore, most surgeons will re-excise to obtain negative margins.[14–16] However, residual disease is not always found in the re-excision specimen, suggesting that some patients potentially could avoid additional surgery if imaging reliably can prove no residual disease exists.

Our goal was to determine whether MRI improved the detection of residual disease in the lumpectomy cavity in patients with positive or close margins after BCT. Also, we sought to evaluate if the length of time between surgery and MRI influenced the ability to detect residual disease.

Methods

Patient selection

A variety of databases containing prospectively collected data collected between January 2003 and June 2008 were reviewed retrospectively. Patients analyzed were treated for breast cancer with excisional biopsy or BCT with or without sentinel lymph node biopsy. Study patients included those with positive margins or close margins defined as 2 mm or less as documented on final pathology or those who had had previous BCT with concern of residual or recurrent disease at the lumpectomy cavity by either postexcision mammography or physical examination. If the patient's original surgery was performed at an outside facility, the histology slides were reviewed at our institution to confirm the findings of close or positive margins as well as the original diagnosis. All the re-excisions were performed at 1 of 2 hospitals within the same institution. All patients underwent MRI at 1 of these 2 hospitals before returning to the operating room for re-excision. Patients with invasive cancer and/or ductal carcinoma in situ (DCIS) were included in the study.

Breast MRI technique

MRI imaging was performed on a 1.5-T General Electric Healthcare (Waukesha, WI, USA) magnet. Patients were placed prone with the breasts positioned properly in a dedicated 8-channel breast coil. Fiduciary markers (vitamin E gel capsules) were applied on nipples and any areas of clinical interest.

The diagnostic MR protocol began with preliminary imaging (of one or both breasts) with fast spin echo sagittal T2 with fat saturation and axial T1 sequences. It was followed by dynamic high-resolution simultaneous imaging of both breasts with the VIBRANT (General Electric Healthcare) sequence performed after intravenous administration of a contrast agent (usually gadolinium, .1 mmol/kg) and using fat saturation.

Three sagittal acquisitions were performed at 30 seconds, 3 minutes, and 6 minutes after the injection, followed by 1 axial T1 fast spoiled gradient (FSPGR) sequence. Postprocessing consisted of 2 series of subtraction images (30 s and 6 min). Slices were 3-mm thick, field of view was 18 to 22 cm and matrix was 256 × 256.

Contrast-enhanced images were sent to the CAD-Stream (Confirma; Bellevue, WA, USA) workstation, a MR computer-aided detection program. Maximum intensity projections, angiogenesis color maps, and time-enhancement kinetic curves can be generated to assist in interpretation.

The examinations were interpreted before all re-excisions by dedicated breast radiologists who specialize in interpreting breast MRI examinations. They always were interpreted in conjunction with a recent mammogram (within 6 months) and ultrasound (the latter when available) and compared with any prior examinations. Morphologic and kinetic features of the enhancements as well as the lumpectomy cavity were described using Breast MR Lexicon terminology. Those with benign features were characterized as such and those with suspicious findings were labeled as consistent with residual disease.

Surgical methods

BCT methods for nonpalpable tumors used radioactive seed-localization. The use of intraoperative frozen section (FS) assessment for margin evaluation was used at the discretion of the surgeon and pathologist. When FS was used, the surgeon achieved negative margins intraoperatively by frozen pathology. All FS margins were re-reviewed on permanent hematoxylin-eosin stains to confirm margin status. Standard practice at our institution is to achieve negative margins of at least 2 mm including both invasive tumor and DCIS components. If sentinel lymph node biopsy was performed, patients underwent dual mapping with technetium-99–labeled sulfur colloid and isosulfan blue dye. Re-excision was performed as a separate surgery regardless of the MRI findings. Adequate tissue was removed from the margin of the lumpectomy cavity described as close or positive on original pathology. Again, intraoperative FS margin analysis was conducted at the discretion of the surgeon and pathologist to verify clear margins. If FS evaluation showed persistently close or positive margins, further re-excision was performed until margins of at least 2 mm were achieved or it was decided that BCT was not feasible.

Data collection and analysis

Data points collected included patient characteristics such as age, tumor characteristics, indication for re-excision, date of original surgery, date of sentinel lymph node biopsy (if different from date of original surgery), and date