MRI Evaluation of Breast Cancer Residua Soon After Surgery: Appearance and Accuracy

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ABSTRACT:
We attempted to define MRI criteria that would allow discrimination between post-surgical reparative tissue and residual breast malignancy during the timeframe that has greatest clinical value, immediately following attempted surgical resection of a breast neoplasm. Simple enhancement patterns used to categorize 24 patients who were within 6 months of surgery allowed identification of malignant residua with 79% accuracy, even during the first 2 weeks post-surgery. Post-operative MRI proved clinically valuable even in the face of false positive results (as all were adjacent <6mm enhancement foci) allowing a limited re-excision to be performed rather than extensive resection.

MATERIALS AND METHODS:
Demographics: MR-images were evaluated from 24 consecutive patients (with adequate follow-up) who had undergone partial mastectomy procedures within 6 months prior to MRI exam. The mean time interval between surgery and MRI was 22days (range 1-183 days), with 9 patients imaged less than 2 weeks after surgery. Chemo- and/or radiation therapy (XRT) had been used in 13 patients.
Re-excision surgery (mean ___days after MRI, n=__), core biopsy of suspicious lesion (n=1), and 2 year follow-up (n=3) was used for determining final diagnosis.
Technique: Unilateral breast imaging was performed on 1.5T Philips systems, in a bilateral breast coil. This study utilized only the sagittal 3D fat saturated gradient echo T1-weighted series; 1.8mm; 128x256 matrix; 18cm FOV.
Assessment Criteria: A series of criteria for a positive (malignant) diagnosis was created and used for evaluation by a radiologist blind to prior imaging study data. The specific morphologic and contrast enhancement features evaluated using a simple 4 level scale (none, small, medium, large amount): degree of enhancement, cavity rim enhance, globular/foci, linear, and zonal patterns. Small foci/linear enhancement were considered to be 5mm or smaller. The degree of metal artifact and anatomic distortion at the lumpectomy site were also assessed. Skin enhancement and a thin (1-3mm) rim of enhancement at the perimeter of the cavity was considered to be normal. For maximal sensitivity, any non-rim enhancement (or external projection from the rim) that had at least medium degree of enhancement was considered suspicious for malignancy (since most patients had previously documented cancer in that region). Three overall assessment categories also utilized: Positive, Negative, Indeterminate (with the latter being "forced" to one of the former, for final answer).

RESULTS:
Using this simplistic maximally conservative approach to determining residual cancer, the sensitivity was 100% and the specificity 50% and accuracy 79%. There were 14 true positives and 5 true negative results. There were 5 false positives (21 %) and 0 false negatives. The false positives were due to enhancement from areas of LCIS (n=1), inflammation/foreign body reaction (n=3), and florid ductal hyperplasia (n=1). All false positive results were the result of <5mm foci being called suspicious (and one 6mm linear enhancement). Three of the five were also initially thought to be "indeterminate". All five were actually called negative on the original MRI report (albeit using subtly crafted "hedge-words"). Original readings also included false positive and negative results, but are not reported here. The true positive group included 4 with enhancement foci of only 5mm and less. A prominent rim enhancement occurred in 4 patients out of 14 who had residual fluid collections.

DISCUSSION:
Initial studies indicated poor accuracy of MRI if performed within 6 months of surgery or 9 months of XRT (1,2,3). However, it is known that in preoperative situations, MRI is more accurate than other means for determination of breast cancer volume and location (4,5). Thus the "conventional wisdom" to avoid use of MRI in the post-surgical setting may be unwise. Multicentric, multi-focal, and bulky residual disease could go undetected would commonly be found by using MRI, if used. Our initial experience did not suggest that there was an insurmountable problem in this regard. Several authors have found considerable value in post-surgical MRI (6,7). The apparent discrepancy between these reports may, in part, relate to the latter groups using higher resolution techniques. For adequate discrimination, there is a need to separate expected from unexpected post surgical appearances. Perfection may not be required. A key surgical question to be answered is presence or absence of malignancy **beyond** a thin rim of tissue that would normally be taken at the time of re-excision (when positive or "close" margins are reported by the pathologist). The question of whether to re-excise at all, or not is more difficult; however the thin rim of enhancement only obscures (potentially) 1-3 mm sized residua. In some decision trees, this size of lesion residua may be successfully treated with chemotherapy and/or XRT, or be "closely followed" when re-excision is undesired. Using a maximally conservative (avoid false negative) simplistic approach still yielded good results with only 21% "unnecessary" re-excision occurring. Using more complicated morphologic and washout criteria for detection Frei et al (7) provided very strong evidence (92% positive prediction) that MRI was accurate in this setting after 28 days. However, even when MRI examination immediately follows surgery (9 of our patients within 2 weeks, with only 2 false positives), identification of focal globular, mass like, or diffuse prominent enhancement in the vicinity of recently documented malignancy should arouse strong suspicion for residual malignancy. Subsequent re-excision procedure should take this anatomic information into account for optimal patient care. The use of the "indeterminate" designation (initially used in 7 patients total) may also help with patient care as 3 of the 5 false positives initially were of this category, but were designated "positive" when the answer was "forced" for this study. Each lesion was less than 6mm, treatable with shallow re-excision in any case (or potentially with XRT if surgery undesired). The use of vacuum-assisted MR-guided biopsy may also allow intervention to be minimized under these circumstances.
There are significant deficiencies with this analysis. Beyond the obvious need for a larger study group, a major problem is the lack of controlled precision pathologic serial thin sectioning and comparison of histologic specimen with the positions noted on sagittal MRI exam. Highly variable post-MRI clinical situations occurred in this study group, including the use of interval therapy between MRI and definitive surgery (therapy was in progress in over 20% of our patients). There is also potential for bias inherent in any retrospective analysis.

CONCLUSION:
1. Immediate post-operative MRI for assessment of breast cancer residua is potentially valuable for accomplishing or avoiding a breast sparing follow-up procedure, as strong positive or negative diagnosis is frequently possible within 1 week of surgery.
2. Abnormal MRI enhancement patterns extending beyond a 3mm rim of the surgical cavity enhancement, not in overlying skin, should be considered highly suspicious for breast malignancy.

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