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Breast-specific gamma imaging is a cost effective and efficacious imaging modality when compared with MRI

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Abstract

BACKGROUND: Both MRI and breast-specific gamma imaging are tools for surgical planning in newly diagnosed breast cancer. Breast-specific gamma imaging (BSGI) is used less frequently although it is of similar utility and lower cost. We compared the diagnostic and cost efficacy of BSGI with MRI.

METHODS: Retrospective review of 1,480 BSGIs was performed in a community breast health center, 539 had a new diagnosis of cancer, 75 patients having both MRI and BSGI performed within 2 months of each other. Institutional charges for BSGI ($850) and MRI ($3,381) were noted.

RESULTS: BSGI had a sensitivity of 92%, specificity of 73%, PPV of 78%, and NPV of 90%. This compared favorably with MRI that had sensitivity of 89%, specificity 54%, PPV 67%, and NPV 83%. The accuracy of BSGI was higher at 82% vs MRI at 72%. Total cost of MRI imaging was $253,575 vs BSGI at $63,750. Q4

CONCLUSIONS: BSGI is a cost-effective and accurate imaging study for further evaluation of dense breast tissue and new diagnosis of cancer.

There are over 226,000 newly diagnosed cases of breast cancer in the United States annually. As treatment management in both surgery and radiation therapy has become more complex, many of these patients are evaluated with increasingly sophisticated imaging. This is occurring at the same time that there is scrutiny on the use of evidence-based medicine and a call to control the rising cost of medical care.

Recent studies have shown both MRI and breast-specific gamma imaging (BSGI) to be good imaging tools for surgical planning in newly diagnosed breast cancer and for the imaging of dense breasts. BSGI is used less frequently although it appears to be of similar utility and lower cost. There are several studies in the literature comparing the sensitivity and specificity of the 2 modalities but none to our knowledge comparing cost.

Our community comprehensive breast health center added a BSGI to the traditional MRI, ultrasound, and mammography units in 2006. We prospectively collected data on BSGI studies performed. There were occasions when patients had both studies performed in close proximity. This gave our center the opportunity to look retrospectively at clinical results and to compare the studies for outcome. We evaluated the diagnostic and cost efficacy of BSGI compared with MRI.

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Methods

Retrospective data review of 1,480 BSGIs was performed in our community comprehensive breast health center. There were 539 studies performed specifically for a new diagnosis of breast cancer. We retrieved the data specifically on patients who had both an MRI and BSGI performed within 2 months of each other. All BSGI studies were performed using a gamma camera (Dilon 6800; Dilon Technologies, Newport News, VA). This camera uses a high-resolution and small field of view for optimal images. Imaging technique used injection of 20 to 30 mCi (925-110 MBq) of technetium-99m sestamibi into an arm vein using the contralateral side of the diseased breast whenever possible. When an arm vein was not accessible, a dorsalis pedis vein was used instead. Time from injection to the start of imaging procedure was approximately 10 minutes. Craniocaudal and mediolateral views were obtained of both breasts with a total time of 40 minutes (10 minutes per view). Dedicated breast radiologists in our community comprehensive breast health center interpreted films. Information on needle or surgical biopsies and results of final pathology were recorded. Additional imaging studies and their results were also documented, such as mammogram, ultrasound, and MRI, if performed.

MRIs studied may have been performed at institutions outside our breast health center. The institutional fee including professional fees of BSGI ($850) and MRI ($3,381) were calculated from those charged at our facility. Our institutional review board guidelines were observed for this review.

Results

There were 1,480 studies documented in our review and 539 had the study performed for a new diagnosis of breast cancer. Of these, 75 patients had both BSGI and MRI performed within a 2-month period (see Table 1). BSGI had a sensitivity of 92%, specificity of 73%, PPV of 78%, and NPV of 90%. This compared favorably with MRI that had sensitivity of 89%, specificity 54%, PPV 67%, and NPV 83%. The accuracy of BSGI was higher at 82% vs MRI at 72%.

Total charges for MRI vs BSGI were $253,575 versus $63,750. The charges for false positives for MRI vs BSGI were $30,429 vs $8,500 (not including cost of biopsy).

Table 1 Number of cancers and false positives in breast patients with BSGI and MRI studies

	Patients	Cancers detected	False positives
+BSGI/−MRI	8	4	4
+MRI/−BSGI	14	3	11
+BSGI/+MRI	37	31	6
−BSGI/−MRI	16	0	0

Comments

In today's world of fiscal challenges, we are called to provide quality care that is evidence based and to be conscious of the cost of care. As we navigate the new world of fiscal responsibility, the question of routine use of MRI preoperatively is an important one. It is also a fair question to ask if the evidence truly supports the wide spread use of preoperative MRI.

As breast cancer care becomes more complex and we are performing more breast-conserving surgery with radiation fields that are shrinking, some patients are benefited by more in-depth study of the breast tissue. Some argue that improved systemic therapies negate the need for routine use of imaging over and above mammography and ultrasound. This argument holds true for long-term control in patients undergoing breast-conserving therapy. However, practicing surgeons often order MRI in hopes of improving resection margins, ruling out multifocal disease, and evaluating regional nodal basins. In practice, a significant fraction of newly diagnosed breast cancer patients in the United States undergo MRI. Although many question the practice of additional imaging for newly diagnosed breast cancer, the move toward reduced therapy and partial breast radiation necessitates adequate evaluation of the breast tissue. Practitioners, both surgeons and radiation oncologists, should glean the information they need for treatment decisions with less fiscal and personal impact to the patient. The use of BSGI in our series would result in reducing unnecessary biopsies and out of pocket cost.

We initially became interested in MRI with the hope that it would allow us to better understand the extent of disease in the breast, and this would decrease the number of lumpectomies with positive margins and repeat surgery often required in this situation. We know that the extent of disease that we visualize on mammography may be an underestimate of the true extent of disease. This is particularly true when imaging for DCIS. MRI is well studied in this realm. Rosen et al[1] performed an eloquent study of MRI in this setting showing that functional imaging with MRI can delineate the extent of disease far better than mammography alone. Unfortunately, this does not seem to translate into improvement in clear margins of resection on initial surgery. Several series have shown that MRI does not decrease the rates of positive margins and may in fact increase rates of mastectomies.[1] As born out in our review, this comes at considerable fiscal cost as well. Despite several recent reviews questioning the utility of MRI in the perioperative setting for breast cancer, the use of MRI does not appear to be declining.[2,3]

BSGI on the other hand has a sensitivity that parallels that of MRI. It is also able to show the extent of disease and additional cancers with a higher specificity (73% vs 54% for MRI). In our series, the sensitivity, specificity, and accuracy were all higher for BSGI than that of MRI. Killelea et al[4] also reported a similar series in which BSGI

compared favorably with MRI in newly diagnosed breast cancer. Keto et al[5] reported a series specifically comparing BSGI with MRI for evaluation of DCIS and found that the sensitivity between the 2 modalities was comparable. The numbers in this study were too small to draw statistical significance. In another review on the impact that BSGI made on the surgical management of newly diagnosed breast cancers, Killelea et al found that 22% of patients had a change in management. This included a 9% incidence of additional cancer found. This is in keeping with a previously published series from our institution in which the incidence of additional cancers detected was 10.9%, and 16% of patients had a change in management.[6] In yet another series by Tadwalker et al,[7] the reported sensitivity of BSGI was 98% overall. They reported 100% sensitivity for grade 2 and higher tumors regardless of size and 88% sensitivity for sub-centimeter grade 1 disease. Though none of these series are very large, they consistently report BSGI to have sensitivities of more than 88% and high specificity.

Finally, in reviewing the literature, Kim reported a prospective study evaluating MRI vs BSGI in newly diagnosed breast cancer patients with dense breast tissue. They found BSGI to have a slightly lower sensitivity at 89% than MRI at 93%. However, the specificity of BSGI was 90% compared with MRI at 35%. The theme of these studies is that BSGI had sensitivity on par with MRI but a higher specificity.[8] This is validated in a meta-analysis of the available literature on BSGI by Sun et al,[9] in which they concluded that BSGI has a high diagnostic performance as an adjunct to mammography.

This comparison group of newly diagnosed breast cancer showed that BSGI outperformed MRI in the clinical parameters at charges that were $200,000 less. To consider the difference in charges, we can extrapolate to a grander scale. If every newly diagnosed breast cancer patient in the United States had an MRI, the charges would add up to $743 million compared with $187 million in charges to perform BSGI on the same population. On a national level, this would be a huge savings.

There is concern for the radiation exposure associated with BSGI. This has been studied. The current recommended dose for breast imaging for BSGI is ~700 to 900 MBq (20 to 25 millicuries) which is 15 to 30 times the exposure of screen mammography. This is acceptable for a single study in the setting of a new cancer diagnosis but would not be acceptable for annual screening. There are currently studies underway to evaluate lowering the dose given per study yet maintain image quality.[10] Preliminary reports suggest that a dose of 8 millicures (5 times the exposure of a mammogram) may still produce acceptable imaging sensitivity. If these studies confirm efficacy of the lower dose, then molecular imaging may also play more of a role in screening of high-risk populations. Currently, we would recommend its use as an adjunct in the diagnostic setting.

If we objectively look at the evidence on efficacy and cost effectiveness between the 2 studies for imaging newly diagnosed breast cancer, we believe the colloquial term for the comparison between them would be "no brainer." BSGI is clearly a clinically equivalent and less costly imaging study in this setting. It is interesting that despite growing data to support the use of functional imaging, most centers continue to use MRI. Many have made large investments to add breast coils to the MR units, and switching to BSGI would represent an additional investment out lay. Radiologists have also been trained in MRI, often with additive time spent specifically in obtaining expertise in breast MRI. This may partially explain the slow adaption of BSGI. Having a BSGI unit does not eliminate the need for MRI technology in most large centers. BSGI enhances imaging capabilities as it is obtainable even in severely claustrophobic or morbidly obese patients. Q8

Conclusions

BSGI is equivalent to MRI in its sensitivity for detection of breast cancer and superior in specificity. BSGI is a cost-effective and accurate imaging study for further evaluation of patients with dense breast tissue and new diagnosis of cancer and should be the preferred method of imaging evaluation in this setting.

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Discussion

Jonathon Durning, M.D.: Practically, for those of us who do not have this imaging available at our hospitals,

how much does one of these cameras cost and how difficult is it do this imaging? What is the learning curve for interpreting BSGI? Could this help identify an unknown primary in a patient with known axillary disease? Does this work for women with breast implants? Is there a BSGI compatible biopsy system?

The NCCN guidelines address generally the indications for use of breast MRI but make no mention of BSGI. Are there any guidelines on the indications for use of this imaging? BSGI is advocated for imaging dense breast tissue, but is there a definition of dense breast tissue?

As you state in your article, there is little evidence that MRI helps reduce the frequency of lumpectomy margin re-excision, and it may, in fact, unnecessarily increase the rate of mastectomy. In your series, did BSGI reduce the rate of re-excisions? Did BSGI affect the rate of mastectomy? Has BSGI helped reduce the rate of local recurrence or improved survival? In other words, is there an argument for forgoing both MRI and BSGI?