# Detection of Ductal Carcinoma in Situ with Mammography, Breast Specific Gamma Imaging, and Magnetic Resonance Imaging: A Comparative Study[1]

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**Rationale and Objectives.** To evaluate the sensitivity of high-resolution breast-specific gamma imaging (BSGI) for the detection of ductal carcinoma in situ (DCIS) based on histopathology and to compare the sensitivity of BSGI with mammography and magnetic resonance imaging (MRI) for the detection of DCIS.

**Materials and Methods.** Twenty women, mean 55 years (range 34–76 years), with 22 biopsy-proven DCIS were retrospectively reviewed. After injection of 25–30 mCi (925–1,110 MBq) technetium 99m-sestamibi, patients had BSGI with a high-resolution, small-field-of-view gamma camera in craniocaudal and mediolateral oblique projections. BSGI studies were prospectively classified according to focal radiotracer uptake using a 1 to 5 scale, as normal 1), with no focal or diffuse uptake; benign 2), with minimal patchy uptake; probably benign 3), with scattered patchy uptake; probably abnormal 4), with mild focal radiotracer uptake; and abnormal 5), with marked focal radiotracer uptake. Imaging findings were compared to findings at biopsy or surgical excision. The sensitivity of BSGI, mammography, and when performed, MRI were determined for the detection of DCIS. Breast MRI was performed on seven patients with eight biopsy-proven foci. The sensitivities were compared using a two-tailed *t*-test and confidence intervals were determined.

**Results.** Pathologic tumor size of the DCIS ranged from 2 to 21 mm (mean 9.9 mm). Of 22 cases of biopsy-proven DCIS in 20 women, 91% were detected with BSGI, 82% were detected with mammography, and 88% were detected with magnetic resonance imaging. BSGI had the highest sensitivity for the detection of DCIS, although this small sample size did not demonstrate a statistically significant difference. Two cases of DCIS (9%) were diagnosed only after BSGI demonstrated an occult focus of radiotracer uptake in the contralateral breast, previously undetected by mammography. There were two false-negative BSGI studies.

**Conclusions.** BSGI has higher sensitivity for the detection of DCIS than mammography or MRI and can reliably detect small, subcentimeter lesions.

**Key Words.** Breast cancer; molecular imaging; breast biopsy; nuclear medicine imaging.



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Ductal carcinoma in situ (DCIS) occurs in approximately 28% or more than 58,000 cases of breast cancer in the United States (1). Mammography, the only accepted screening tool for breast cancer, detects the majority of clinically occult DCIS as microcalcifications, the hallmark mammographic finding of DCIS (2). Yet, the diagnosis of DCIS remains difficult because mammography is unreliable in predicting the histology and extent of DCIS (2–5).

Breast MRI has been shown to have a sensitivity of 73%–89% for DCIS, but a limited specificity (58%–89%) and variable positive predictive value (25%–84%) (1–3,5). As with mammography, small foci of DCIS are difficult to detect on magnetic resonance imaging (MRI), particularly lesions smaller than 5 mm (6,8). In addition, MRI may overestimate DCIS extent in as many as 50% of cases and often cannot distinguish benign from malignant lesions, high-grade from low-grade DCIS, or detect an invasive component concurrent with the DCIS (3–5). As a result, MRI remains a secondary study with limitations in DCIS detection and evaluation.

Breast specific gamma imaging (BSGI), nuclear medicine imaging of the breast using a high-resolution gamma camera, is an increasingly used adjunct imaging modality for the diagnosis of breast cancer. Recent studies have shown the potential of BSGI as a valuable complement to mammography in detecting breast cancer (9–12).

The purpose of this study is to determine the sensitivity of BSGI, mammography, and MRI for the detection of DCIS and to compare the sensitivity of BSGI with mammography and MRI.[4]

## MATERIALS AND METHODS

Between July 2001 and July 2006, 290 underwent clinically indicated BSGI for equivocal or suspicious mammographic findings. Twenty nonpregnant women, mean 55 years (range 34–76 years), were diagnosed with pure DCIS after definitive biopsy or at surgical excision. Retrospective review of these 20 women was performed and constitutes the study population.

BSGI was performed before biopsy to further evaluate an indeterminate breast finding and after biopsy demonstrating DCIS to evaluate for occult foci as well as to determine extent of disease for surgical planning. Pathologic results were correlated with mammography, BSGI, and MRI when deemed indicated for the clinical care of the patient. Pathology reports were retrospectively reviewed for tumor size and nuclear grade. The highest nuclear grade reported on biopsy or surgical excision was included in the analysis.

BSGI was performed after injection of 25–30 mCi (925–1,110 MBq) technetium 99m-sestamibi in an antecubital vein. Patients were imaged with a high-resolution, small-field-of-view breast-specific gamma camera (Dilon 6800; Dilon Technologies, Newport News, VA). Craniocaudal and mediolateral oblique projections were obtained, as were additional projections as clinically indicated. The acquisition time for each image was approximately 10 minutes, with a total imaging time of approximately 40 minutes per study.

BSGI studies were prospectively read by two radiologists with expertise in BSGI interpretation. Correlation with mammography and MRI was made when available. BSGI was classified according to focal radiotracer uptake using a 1 to 5 scale, as 1) normal with no focal or diffuse uptake; 2) benign with minimal patchy uptake; 3) probably benign with scattered patchy uptake; 4) probably abnormal with mild focal radiotracer uptake; and 5) abnormal with marked focal radiotracer uptake.

Mammography was performed (GE DMR, Milwaukee, WI) initially in the craniocaudal and mediolateral oblique projections. Additional views were obtained as deemed clinically indicated by the interpreting radiologist. Results were based on mammographic findings in the clinical report obtained from the patient record.

MRI was performed using a GE 1.5-T system (GE Healthcare, Milwaukee, WI) using a dedicated breast coil. An initial three-dimensional localizing sequence was performed, followed by sagittal T1 with fat saturation (repetition time 525 milliseconds/echo time 12–24 milliseconds), T2 with fat saturation (6,000/85), and axial T2 (6,000/85) fat-saturated sequences. After administration of 33 mL of gadopentetate-dimeglumine (Magnevist, Berlex, Germany) three-dimensional volumetric dynamic images were obtained at 70-second intervals for a total of five cycles followed by a sagittal T1 (6.3/2.9–12) fat-saturated postcontrast sequence. MRI results were based on the generated report in the patient record. MRI and BSGI examinations were performed within 2 weeks.

The sensitivity of BSGI, mammography, and, when performed, MRI were determined for the detection of DCIS and compared using a two-tailed *t*-test. Statistical significance was defined as being with in the 95% confidence intervals.