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Feasibility of Contrast-Enhanced Mammography in Women with Breast Implants

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Abstract

Contrast-enhanced mammography (CEM) may provide an alternative to magnetic resonance imaging as a diagnostic exam in women with known or suspected breast cancer or as a screening exam in women at increased risk of breast cancer. Women with breast augmentation, either for oncologic or cosmetic reasons, may fall into this increased risk population and need safe and effective screening and diagnostic imaging tools. Here, we present our clinical practice data in order to demonstrate the feasibility of CEM in women with breast implants. An institutional review board-approved, Health Insurance Portability and Accountability Act-compliant, retrospective review of our tertiary cancer center's database yielded 104 women with breast implants who underwent 198 CEM exams from November 2014 to March 2020. All 198/198 (100%) exams were successfully completed in 104 women. Exam indications included: 174/198 (88%) screening due to increased risk, 10/198 (5%) to evaluate a palpable abnormality, 9/198 (<5%) to evaluate disease extent following neoadjuvant chemotherapy for a known breast malignancy, and 5/198 (<3%) for a 6-month follow-up. 97/104 (93%) women had dense breasts. Routine and implant-displaced low-energy views were obtained with contrast-enhanced images obtained on displaced views for all patients. 197/198 (99.5%) exams yielded no complications. In one exam, the patient experienced mild vasovagal symptoms following the administration of contrast. In conclusion, it is feasible to utilize CEM in both diagnostic and screening capacities in women with breast implants.

Keywords

contrast-enhanced mammography; breast implants; screening; high-risk screening

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Introduction

Contrast-enhanced mammography (CEM) is gaining a foothold within both diagnostic and screening breast imaging settings. CEM allows for the evaluation of not only anatomic information but also the functional information of enhancing neovascularity, akin to contrast-enhanced breast magnetic resonance imaging (MRI).

Early research into CEM focused primarily on the diagnostic setting, with an emphasis on its use for the diagnostic evaluation of screen-detected abnormalities[1] and abnormal clinical findings.[2] Diagnostic evaluation by CEM was then expanded to include those patients with a known diagnosis of cancer requiring preoperative staging assessment as well as those receiving systemic neoadjuvant chemotherapy.[3]

Once the role of CEM in the diagnostic setting was more clearly delineated, investigators began to explore the role of CEM in the screening setting. Early investigations focused on screening in increased risk populations, including women at intermediate risk (15%–19% lifetime risk) and women at high risk (≥ 20% lifetime risk). Women at high risk include those with deleterious gene mutations and their untested first-degree relatives, women with a strong family history of breast cancer, women with a history of chest irradiation between 10 and 30 years of age, and women with dense breasts and a personal history of breast cancer or a personal history of pre-menopausal breast cancer. Researchers found that CEM had an improved sensitivity over standard digital mammography (87.3% vs. 50%) while still maintaining an acceptable positive predictive value.[4] In women with both intermediate risk and dense breast tissue, Sorin et al. found that CEM had an improved sensitivity in detecting breast cancer when compared with standard mammography (90.5% vs 52.4%), although CEM had a lower specificity (76.1% vs 90.5%).[5] In women with intermediate risk secondary to a personal history of lobular neoplasia, Hogan et al. [6] showed that CEM had both high sensitivity and specificity.

While MRI remains the gold standard for high-risk screening, it is expensive, not always readily available, and not always possible in certain individuals (i.e., those with pacemakers or who have severe anxiety/claustrophobia). This has led to further interest in advancing CEM as an alternative technique for screening intermediate- to high-risk women. And while these retrospective studies have shown a potential benefit of CEM over standard mammography, larger-scale, prospective data are needed to confirm the retrospective findings. Of note, a prospective, multicenter American College of Radiology Imaging Network (ACRIN) trial, the “Contrast Enhanced Mammography Imaging Screening Trial (CMIST),” is being planned, which will compare CEM to digital breast tomosynthesis (DBT) in the screening of women at average-to-intermediate risk who have mammographically dense breasts.

A Unique Population: Imaging Women with Breast Implants

As CEM becomes more widely available and its uses more clearly delineated, its applications to particular subgroups need to be assessed. One such subgroup of women is those with breast implants.

Many investigators have looked at the effects of breast implant augmentation on screening mammography, showing an overall decrease in measurable breast tissue in women following breast implant augmentation. The amount of visualized tissue is correlated with the degree of capsular contracture, implant position, preoperative breast size, implant size, and implant type. In addition, women with implants undergo two sets of images – standard views and implant-displaced views – which increases the overall exam dose.

Despite these concerns, a study by Kopans et al. showed no significant difference in recall rates for women with breast implants compared to those without implants or to those with a history of prior breast cancer treatment.[7] Another study by Kam et al. showed no significant difference in the cancer detection rate for women with implants compared to those without implants.[8] Thus, both studies support the continued use of screening mammography in women with breast implants.

Women with breast implants can also have additional history which puts them into a greater-than-average risk category for the development of breast cancer, thus necessitating advanced imaging for the screening and diagnosis of breast cancer in this population. Unfortunately, however, women with breast implants have been excluded from some research with CEM, purely due to the presence of their implants. It is in this population that our institution has begun using CEM.

Technique

An institutional review board-approved, Health Insurance Portability and Accountability Act-compliant, retrospective review of our large tertiary cancer center's database yielded 104 women with breast implants who underwent 198 CEM exams from November 2014 to March 2020. The electronic medical record as well as images and radiology reports from the institutional Picture Archiving and Communication System were reviewed for exam indication, technique, and patient characteristics including breast density and implant type, both subjectively assessed by the reporting radiologist at the time of clinical interpretation. Complications related to the CEM exam were also recorded.

All CEM examinations were performed on a dual-energy mammography system (Senographic Essential; GE Medical Systems, Milwaukee, WI). Prior to contrast administration, standard non-displaced craniocaudal and mediolateral oblique views were obtained for each breast. Then, each patient received Iohexol (Omnipaque 350; GE Healthcare) at a dose of 1.5 ml/kg via intravenous power injection at a rate of 3 ml/s up to a maximum dose of 150 ml. Once contrast injection was completed, a delay of approximately 2.5 min occurred so the patient could be positioned for the CEM portion of the exam. Implant-displaced craniocaudal and mediolateral oblique views of each breast were then obtained. Each view was imaged with two almost simultaneous exposures, a low energy exposure (26–30 kVp) and a high energy exposure (45–49 kVp), in order to straddle the K-edge of iodine. The low-energy images served as the equivalent of a 2D full-field digital mammogram. Iodine images recombined the low and high-energy images by using a proprietary algorithm to elucidate areas of contrast enhancement.

Clinical Experience

All 198/198 (100%) exams in 104 women were successfully completed: 32/104 (31%) women had saline implants, 70/104 (67%) had silicone implants, and 2/104 (2%) had one saline and one silicone implant. 94/104 (90%) women had subpectoral implants and 10/104 (10%) women had retroglandular implants. 102/198 (52%) exams were bilateral and 96/198 (48%) unilateral. Exam indications included: 174/198 (88%) screening exams due to increased risk, 10/198 (5%) exams for a palpable abnormality, 9/198 (< 5%) exams for evaluation of disease extent following neoadjuvant chemotherapy for a known breast malignancy, and 5/198 (< 3%) exams performed as a 6-month follow-up to a previously abnormal CEM exam. 97/104 (93%) women had dense breasts. 197/198 (99.5%) exams yielded no complications. In one exam, the patient experienced mild vasovagal symptoms following administration of contrast but was able to complete the exam. See Figure 1 for an example of a high-risk screening CEM in a patient with silicone breast implants.

It is current practice at our institution to interpret all CEM exams in real time, thus limiting our ability to calculate a true “call-back” rate in the subgroup of patients who underwent a screening CEM exam. Of the 174 screening CEM exams, 59 patients had a same-day screening ultrasound exam and 11 patients had a same-day diagnostic ultrasound exam for further evaluation of a mammographic finding. No patients underwent concurrent (within one month) screening MRI. When stratified by BI-RADS category, of the 174 screening CEM exams, 19 exams (11%) were given a BI-RADS 0, 3, or 4 category and were recommended for additional imaging and or biopsy. Specifically, 12 (7%) women were recommended to undergo further evaluation of a CEM-only finding with MRI, 3 women were recommended for short interval follow-up based on a non-enhancing mammographic finding, and 2 were recommended for biopsy of non-enhancing calcifications seen on the low-energy mammography images. The additional imaging and/or biopsies in these 19 women did not results in diagnosis of a cancer. Given our relatively small sample size, we were unable to perform statistical analysis of mammography standard benchmarks; however, we hope to report on this data in the future as we evaluate more patients with breast implants.

In the patient sample that was evaluated, only one cancer was found, which was mammographically occult but was detected on a concurrently performed screening breast ultrasound. The same-day CEM exam had marked background parenchymal enhancement obscuring the underlying lesion; however, evaluation of the area was not impacted by the in-situ breast implant.

Lastly, of the 9 exams performed for evaluation of disease extent following neoadjuvant chemotherapy, all had a contrast-enhanced breast MRI performed within a 7-day window. Results of the CEM and MRI exams were concordant in all cases, showing either decreased or resolved malignant enhancement. No additional sites of disease were identified.

Conclusions

CEM is a promising modality for the screening and diagnostic evaluation of breast cancer. The exam is currently being used clinically at our institution for a wide variety

of indications; however, most exams are performed for screening in intermediate risk populations, especially in women with dense breasts. As the uses of CEM continue to expand, we have successfully included women with breast implant augmentation for imaging with CEM. Our cohort of women with breast implants undergoing CEM is small and covers a wide range of indications beyond just screening, which limits our ability to assess parameters such as sensitivity and specificity for cancer detection. Further research and inclusion of these women within our standard practice protocols is necessary to gain a better understanding of the utility of this modality in this specific population.

While the limits of mammography in augmented breasts still exist, including a decrease in measurable/visualized breast tissue and increased mean glandular dose, CEM is technically feasible and may serve as a good alternative for those women at increased risk who cannot undergo screening with MRI.

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Highlights:

- Contrast-enhanced mammography is increasingly being utilized as a screening and diagnostic tool for women at intermediate to high risk of breast cancer.
- Women with breast augmentation present a unique population that require attention and inclusion in screening and diagnostic imaging paradigms.
- Contrast-enhanced mammography is a technically feasible breast imaging exam in women with breast implants.

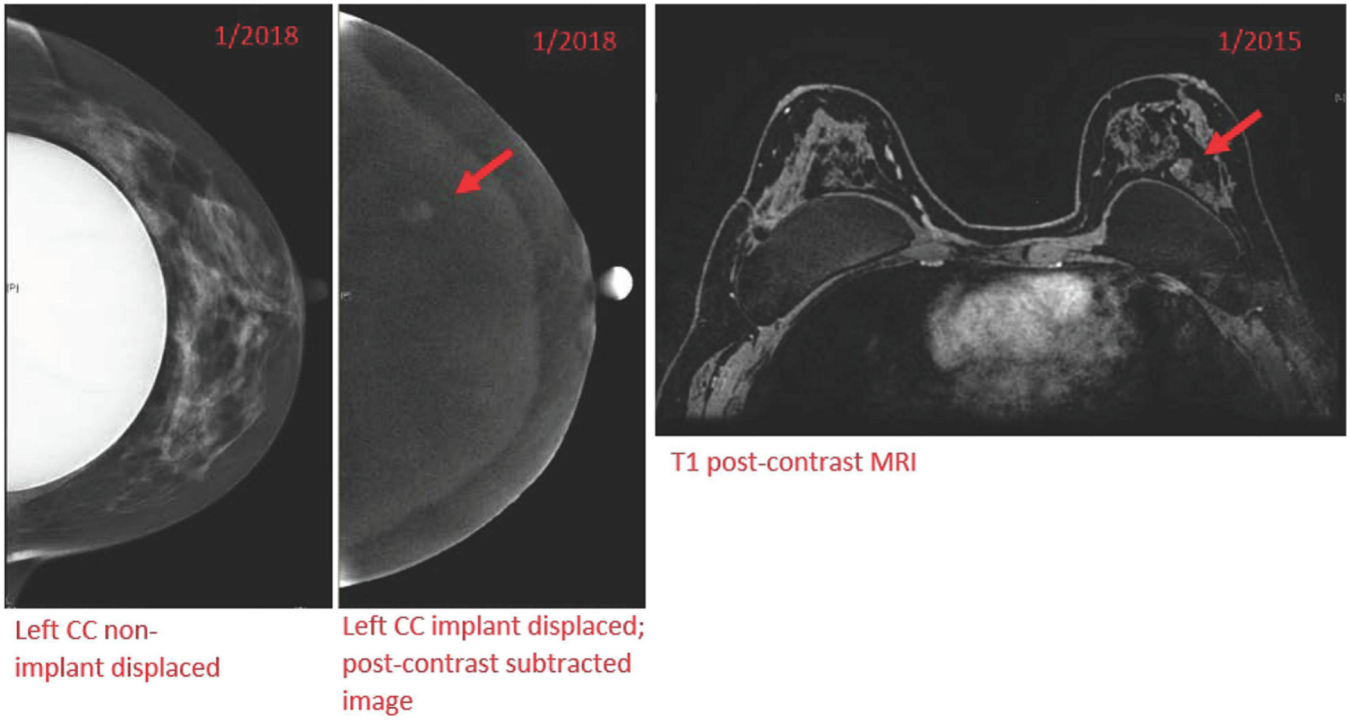

Figure 1.

51-year-old woman in whom CEM was performed for high-risk screening. (A) A subpectoral silicone implant is in place. (B) Post-contrast implant displaced mammography demonstrates a circumscribed enhancing mass, correlating with (C) a stable benign mass on a prior MRI. The mass was assessed as BI-RADS 2.