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# Utility of routine use of breast ultrasound following contrast-enhanced spectral mammography

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ARTICLE INFORMATION

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AIM: To evaluate whether breast ultrasound (US) is routinely indicated following contrast-enhanced spectral mammography (CESM).

MATERIALS AND METHODS: Consecutive screening and diagnostic CESM examinations with concurrent breast US were collected retrospectively (May 2012 to February 2016). Radiologists assigned a separate Breast Imaging-Reporting and Data System (BIRADS) score for CESM and for US. BIRADS scores were grouped into three categories: normal/benign appearing (BIRADS 1, 2); probably benign, short-term follow-up (BIRADS 3); or suspicious appearing (BIRADS 0, 4, 5). Patients with a suspicious-appearing lesion in either US or CESM underwent biopsy. The associations between malignant pathology with either suspicious-appearing CESM or suspicious-appearing US were calculated. The sensitivities and specificities of CESM and US were analysed.

RESULTS: Eighty-seven lesions were biopsied, 37 (43%) biopsies were malignant and 50 (57%) were benign. Although suspicious-appearing CESM was associated with malignant biopsies ($p<0.0001$), suspicious-appearing US was not ($p=0.985$). Among 37 malignant biopsies, CESM had a sensitivity of 97% (36/37 lesions), compared to 92% (34/37 lesions) with US. None of the malignant biopsies were normal/benign appearing with CESM. One case of follow-up CESM was suspicious-appearing at US and proved to be malignant on biopsy. The specificity of CESM was 40%, which was significantly higher than US at 8%.

CONCLUSION: When CESM is suspicious appearing, subsequent US and biopsy is appropriate. With a CESM BIRADS 3, correlation with US is suggested. If the CESM is benign appearing, the routine use of US is questionable, as it may lead to unnecessary benign biopsies.



## Introduction

Breast cancer is the most commonly diagnosed cancer among women and ranks second among all cancers in female mortality.[1] Early detection improves survival, making early identification of breast cancer imperative for

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lengthening survival time.[2] Currently, mammography is the only approved breast cancer screening test, and has been shown to decrease mortality in breast cancer patients.[3–5] Despite mammography being the reference standard for diagnosing breast cancer, factors such as breast density have been shown to lower its sensitivity.[6]

Mammography with supplementary ultrasound (US) is recommended in women with dense breast parenchyma, as concurrent use has been shown to detect more malignant lesions in this population.[7,8] Both mammography and US can be used separately for breast cancer detection as well. Concomitant US and mammography does result in an increased false-positive (FP) rate.[9] US has high sensitivity for finding lesions in the breast, but low specificity for malignancy, leading to an increased number of benign biopsies.[10,11]

Contrast-enhanced spectral mammography (CESM) is a relatively novel technique for breast cancer assessment, approved for use by the US Food and Drug Administration (FDA) in 2011. CESM provides anatomical and functional imaging of breast tissue, combining the standard two-dimensional (2D) digital mammography performed following the intravenous injection of an iodine-based contrast agent. Contrast material accumulates in metabolically active tissue with increased vascular supply, and is therefore, useful in identifying cancerous lesions.[12,13] Unlike conventional mammography, CESM is mostly unaffected by dense breast tissue, and is preferred over unenhanced mammography in women with dense breast tissue.[14] CESM has been shown to have a slightly higher sensitivity than conventional mammography, and the increase in sensitivity is amplified in denser breast tissue.[15] Although US is indicated following mammography in women with dense breasts, very little is reported about the utility of breast US in addition to CESM. The aim of this study was to evaluate whether breast US is routinely indicated following CESM.

## Materials and methods

### *US and CESM technique*

An institutional review board approval was granted for this retrospective study. This review was a retrospective study with analysis of interpretations given at the time of the radiological studies. On searching the institutional database, 953 patients who underwent CESM between May 2012 and February 2016 were identified. Subsequent breast US examination was conducted for 1,669 breasts. The average age of the patients was 51.8±9 years. Previous medical history and additional data for patients included in this study are shown in Tables 1 and 2.

The standard of care is to perform US after mammography in women with dense breast tissue. As CESM is a new technique, an attempt was wanted to ensure we do not miss findings in cases of a normal CESM, US was performed on the majority of high-risk patients regardless of their breast density. US examinations were always bilateral and of the whole-breast and were performed with a hand-held device.

**Table 1**
Previous medical history for patients in this study.

| History | *n* (%) |
|---|---|
| Known familial predisposition (breast, ovarian cancer) | 207 (21.7%) |
| Known breast tumour (right breast) | 37 (3.9%) |
| Known breast tumour (left breast) | 35 (3.7%) |
| Known other tumour/metastasis | 13 (1.4%) |
| S/P right lumpectomy | 97 (10.2%) |
| S/P left lumpectomy | 105 (11%) |
| S/P right mastectomy | 17 (1.8%) |
| S/P left mastectomy | 11 (1.2%) |
| Breast density BIRADS[a] | |
| BIRADS 0 | 9 (1%) |
| BIRADS 1 | 7 (0.7%) |
| BIRADS 2 | 104 (11%) |
| BIRADS 3 | 776 (82.3%) |
| BIRADS 4 | 47 (5%) |
| NS | 10 |

BIRADS, Breast Imaging-Reporting and Data System; NS, not specified; s/p, status post.
[a] The 10 NS were excluded when calculating percentages.

**Table 2**
Indications for mammography.

| Indication | *n* (%) |
|---|---|
| Screening | 725 (76.1%) |
| Mastitis | 4 (0.4%) |
| Palpable lump right | 61 (6.4%) |
| Palpable lump left | 83 (8.7%) |
| Breast tenderness right | 14 (1.5%) |
| Breast tenderness left | 29 (3%) |
| Nipple discharge right/retraction | 8 (0.8%) |
| Nipple discharge left/retraction | 5 (0.5%) |
| Pre-op FNL | 12 (1.3%) |
| MG known nodule follow-up | 18 (1.9%) |
| Search for primary breast cancer | 8 (0.8%) |

FNL, fine-needle localisation; MG, mammography.

Although the standard of care in the time frame of the study was US following CESM examinations, a minority of the women did not undergo US for the following reasons: patients with recent US conducted in the previous 3 months; women who preferred not to undergo the recommended US; and patients with prior mastectomies only underwent unilateral US.

All CESM studies were performed on a digital mammography system (Senographe Essential, GE Healthcare; Chalfont St Giles, UK) upgraded to enable the acquisition of dual-energy exposures. Low-energy exposures were obtained at 27–31 kVp with the use of molybdenum and rhodium targets and filters. High-energy exposures were acquired at 45–50 kVp using a molybdenum target with an aluminium and copper filter. Using an image-processing software algorithm, the two exposures were subtracted, generating two images: one low-energy image, providing maximum soft-tissue contrast, and one subtracted image displaying areas of contrast enhancement only. A dose of 1.5 ml/kg body weight non-ionic contrast agent (Iopamiro 370, Bracco S.p.A, Milano, Italy) was intravenously injected in the antecubital fossa, using an automated power injector (Medrad Mark V ProVis; Bayer HealthCare) at a flow rate of 3 ml/s, followed by a saline flush.

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