Emerging Tools in the Detection of Breast Cancer: Comparison of Contrast Enhanced Spectral Mammography with Digital Breast Tomosynthesis to Contrast Enhanced Magnetic Resonance Imaging as an Adjunctive Imaging Modality to 2D Mammography and Targeted Ultrasound

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INTRODUCTION

The current standard of care for patients diagnosed with breast cancer is limited in both the accuracy and ease of imaging modalities. Conventional 2D mammography and ultrasound frequently underestimate the size and number of tumor foci. Contrast Enhanced Magnetic Resonance Imaging (MRI) is more sensitive than 2D mammography and ultrasound, but suffers from low specificity, which can result in unnecessary biopsies or even mastectomy. In addition, MRI is expensive and uncomfortable for patients. A major factor contributing to the limited performance of 2D mammography is the superimposition of breast tissue in dense breasts. Overlapping breast tissue can obscure a lesion, making it more difficult to perceive or even completely mammographically occult. Digital Breast Tomosynthesis (DBT), or 3D mammography, has the ability to detect more cancers by decreasing or eliminating the superimposition of breast tissue. Another imaging modality, Contrast Enhanced Spectral Mammography (CESM), has shown promise in both the accurate evaluation of the size of the index tumor and the identification of additional cancers with better specificity than MRI. It may also have added value as supplemental screening tool for patients diagnosed with breast cancer.

METHODS

Patients with newly diagnosed breast cancer underwent the following imaging procedures prior to any medical, radiation, or surgical therapy:

- 2D Mammography
- Ultrasound (US)
- Digital Breast Tomosynthesis (DBT): low dose projection images are obtained and reconstructed into high-resolution 1mm slices.
- Contrast Enhanced Magnetic Resonance Imaging (MRI): multiple sequences before and after intravenous injection of gadolinium-based contrast agent and subtraction images allow for dynamic evaluation of enhancing lesions.

RESULTS

Case 1: Invasive ductal carcinoma of the left breast was depicted much more clearly on MRI, CESM, and DBT than on 2D Mammogram and Ultrasound. (A) 2D Mammogram CC view. (B) 2D Mammogram MLO view. A central mass with architectural distortion corresponding to a palpable lump is seen only on the CC view. (C) Targeted Ultrasound of the palpable lump reveals very subtle mass at 11:00 position 9cm from the nipple. (D) DBT CC view. (E) DBT MLO view. The cancer is clearly seen on both views using DBT. (F) CESM CC view. (G) CESM MLO view. CESM clearly shows the known cancer. (H) MRI CC view demonstrates an enhancing mass consistent with the biopsy-proven malignancy.

Case 2: MRI and CESM more accurately identify the extent of invasive ductal carcinoma than 2D Mammogram and Targeted Ultrasound. (A) 2D Mammogram ML view depicts an asymmetry in the left breast. (B) Ultrasound reveals a 6x2x3 mm mass. (C) MRI CC view shows a 30 mm linear area of non-mass enhancement with mixed washout kinetics representing the known invasive cancer plus in situ cancer. (D) DBT shows a 21 mm mass with architectural distortion corresponding to the known cancer. (E) On CESM, the cancer measures 25 mm. On surgical pathology, the cancer measured 25 mm.

Case 3: CESM, DBT, and MRI identified additional lesions in a patient diagnosed with invasive ductal carcinoma of the left breast. (A) 2D Mammogram CC view shows a single mass in the posterior 11:00 position. (B) Targeted US identifies the index lesion at 11:00. (C) US identifies an additional lesion in the anterior 12:00 position (red). (D) DBT CC view shows the 2 biopsy-proven cancers in the posterior 11:00 position and anterior 12:00 position. An additional irregular mass with architectural distortion that was not seen on 2D mammogram or Ultrasound was seen on DBT in the middle 10:00 position (green). (E) MRI CC view shows a total of 4 masses, including the 3 seen on DBT as well as an additional lesion in the middle 11:00 position not seen on DBT (orange). (F) CESM CC view identifies all 4 masses representing the known malignancy, corresponding to the masses seen on MRI.

CONCLUSION

CESM combined with DBT is an extremely promising new method of identifying breast cancers and appears to do so with accuracy on par with MRI and significantly superior to 2D Mammography and Targeted Ultrasound. Additional patients will continue to be recruited for the study to corroborate these results.

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