The Egyptian Journal of Radiology and Nuclear Medicine (2015) **46**, 811–819

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

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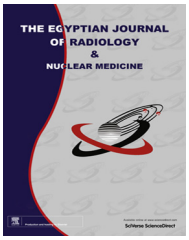

ORIGINAL ARTICLE

Contrast enhanced digital mammography: Is it useful in detecting lesions in edematous breast?

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Received 27 September 2014; accepted 6 April 2015
Available online 18 May 2015

KEYWORDS

High energy digital mammography;
Contrast enhanced digital mammography;
Breast edema

Abstract *Introduction:* Breast edema can be caused by a variety of pathologic processes of benign or malignant diseases. Contrast enhanced digital mammogram (CEDM) has been shown to improve the probability of malignancy detection when compared with the conventional mammography alone.

Patients and methods: This study was prospectively carried on 34 female patients with breast edema at the female imaging unit of the Radiology Department. The age range was 29–80 years. Bilateral conventional mammography (MX) and contrast-enhanced digital mammographic procedure (CEDM) were performed in approximately 7–10 min and followed by complementary ultrasound (US).

Results: As regards enhancement patterns in our study, noncontrast uptake and diffuse parenchymal uptake were considered as benign and intense contrast uptake is considered malignant and ring enhancement in keeping with both benign and malignant lesions.

The calculated sensitivity and specificity of dual energy contrast enhanced digital mammography were 95%, and 73% respectively, with a positive predictive value (PPV) of 88% and negative predictive value (NPV) of 88%.

Conclusion: Dual-energy contrast-enhanced digital mammography is a useful technique in identification of lesions in mammographically dense edematous breasts and proved to be a useful tool in the follow-up of cases presenting by edema after conservative breast surgery and chemotherapy.

1. Introduction

The accuracy of mammography is limited in dense breasts where surrounding fibroglandular tissue decreases the conspicuity of lesions. Even when tumors are detected, the full extent of disease may not be clearly depicted. The primary and metastatic potential of tumors can be directly linked to angiogenesis. Growth beyond a few millimeters in diameter requires the formation of new blood vessels to supply the oxygen and nutrients necessary for survival (1). Tumor angiogenesis factors stimulate formation of abnormal vessels that leak and shunt blood. Therefore, imaging methods with contrast

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Peer review under responsibility of Egyptian Society of Radiology and Nuclear Medicine.

http://dx.doi.org/10.1016/j.ejrnm.2015.04.002

medium potentially can aid in the detection and diagnosis of cancer (1).

Breast edema can be caused by a variety of pathologic processes of benign or malignant diseases. It may occur with inflammatory breast carcinoma, lymphatic obstruction, mastitis, lymphoma, post-radiation changes or systemic conditions such as congestive heart failure and nephritic syndrome (1).

The mammographic findings of breast edema are skin thickening and increased parenchymal density with prominent interstitial markings.

On ultrasonography, it presents as marked skin thickening and increased echogenicity of the subcutaneous fat layer with a reticular anechoic structure, which is suggestive of dilated lymphatics (1).

CEDM has been shown to improve the probability of malignancy detection when compared with the conventional mammography alone. CEDM is a useful adjunct to diagnostic mammography and a promising problem-solving tool (2).

Despite the overlap between post treatment changes and tumor recurrence, the two entities can usually be distinguished by the characteristic mammographic appearances of post treatment sequelae and by comparing interval findings on successive studies. Postoperative masses and fluid collections slowly diminish in size and usually resolve by 1 year after surgery. Radiation-induced edema gradually resolves; increasing edema may be due to recurrent cancer. Postsurgical scarring usually appears as a poorly marginated soft-tissue mass with interspersed radiolucent areas. Recurrent cancer is usually seen as a mass with no central radiolucent areas. Pleomorphic and granular microcalcifications are important markers for recurrent cancer and can usually be distinguished from the thick, calcified plaques and elongated dystrophic calcifications associated with scarring.

2. Patients and methods

2.1. Patients

This study was prospectively carried on 34 female patients with breast edema (1) at our female imaging unit. Patients were referred from the outpatient clinics of the internal medicine, surgery and radiotherapy departments. The age range was 29–80 years.

Comprehensive explanations of the procedures were provided for all cases, including the associated risks and contraindications. They agreed with a written consent to undergo the contrast-enhanced digital mammographic examination after performing renal function tests.

The study has been approved by the institutional board.

Inclusion Criteria: 1. Patients presenting by unilateral or bilateral breast edema on conventional imaging (conventional mammography and ultrasound) warranting detection and characterization of breast lesions. 2. Patients who had undergone conservative breast surgery or chemotherapy with newly developed breast edema with suspected residual or recurrent pathology.

Exclusion Criteria: (1) The early post-operative cases or recently treated with radio-therapy, so as to minimize false positive results. (2) Contraindication to IV contrasts material injection, such as: Allergic patients or those known to have history of complications from contrast media such as anaphylactic reaction. (3) Patients with renal failure. (4) Patients with bad general condition. (5) Pregnant females.

All patients were submitted to the following:

I Clinical history: Full history taking including clinical presentation (complaint), age, family and past medical history.
II Mammographic, ultrasound and CEDM examination.
III Pathologic diagnosis: Analysis of obtained biopsies whether by fine-needle aspiration cytology, needle biopsy, excisional biopsy, or by radical surgery, all of which were diagnosed by experienced pathologists in the analysis of breast cancer.

2.2. Contrast agent

The contrast agent used was the nonionic solution (iohexol, Omnipaque 300; Nycomed, Roskilde, Denmark) containing 300 mg of iodine per milliliter, which is commonly used for CT. In our study, we injected 1.5 ml/kg of the agent by hand over a period of approximately 1 min with a maximum of 120 ml.

2.3. Instrumentation

All images were acquired with a production system (Senobright; GE Medical Systems, Milwaukee, Wis). GE Healthcare's new SenoBright Contrast Enhanced Spectral Mammography (CESM) technology was designed to allow the physician to image blood flow through angiography of the breast using a contrast agent and a dual energy acquisition technique.

2.4. Technique

This consisted of high-energy and low-energy digital mammograms obtained after administration of iodinated contrast agent.

Here, the nonionic iodine contrast agent was injected between pre and postcontrast image acquisitions in which the X-ray beam is produced at a relatively high energy, above the K-edge of iodine. The images were subtracted, canceling the soft-tissue contrast that is common to the two images and isolating the iodine signal in the region of angiogenesis.

At first bilateral conventional mammography both cranio-caudal and medio-lateral oblique views were taken. Then typically, the contrast-enhanced digital mammographic procedure was performed in approximately 7–10 min. This included 3 min for placement of the intravenous catheter and contrast injection, 1 min for obtaining the cranio-caudal image for the normal breast, and 3–6 min for acquisition of the rest of images (the cranio-caudal and the medio-lateral oblique projections for the abnormal breast) followed by the medio-lateral oblique view of the normal side.

Finally, the lesions were analyzed by three specialized radiologists for the presence, morphology, and pattern of enhancement.

2.5. Statistics

Using the standard of reference, sensitivity, specificity, and accuracy were calculated (3). In addition, comparison between groups was performed using the unpaired *t* test and McNemar