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ORIGINAL ARTICLE

Detection and diagnosis of breast lesions: Performance evaluation of digital breast tomosynthesis and magnetic resonance mammography

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Abstract *Objective:* To assess the impact of digital breast tomosynthesis (DBT) and magnetic resonance mammography (MRM) in enhancing the performance of digital mammography (DM) in the detection and evaluation of different breast lesions.
Patients and methods: In this retrospective study, 98 patients with 103 breast lesions were assessed by DM, DBT and MRM. Mammography images were acquired using the "combo mode", where both DM and DBT scanned in the same compression. MRM was performed by 1T open system. Each lesion was assigned a blinded category in an individual performance for each modality. The resultant BI-RADS categories were correlated with reports of the pathology specimens or outcome of 18-month follow-up.
Results: Both DBT and MRM showed equivalent sensitivity of 92%. The specificity for DBT and MRM was 80.7% and 89.7% respectively. The efficacy of DM was raised from 61% to 83.5% with DBT and 90.2% with MRM. The results of the three modalities and the final diagnosis revealed a significant correlation ($p = 0.035$).The association between the results of DBT and those of MRM showed statistically significant difference between DBT and MRM for diagnosing breast lesions ($p = 0.001$).
Conclusion: Both MRM and DBT provide better performance than classic DM. Adding either of these modalities to the classic examination enhances diagnosis and precise disease distribution.

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1. Introduction

Optimal treatment and prognosis assessment require accurate diagnosis. Mammography still has its special place in breast imaging of symptomatic women, yet its low sensitivity due to the misinterpretation of architectural distortion, asymmetrical density, and overlapping glandular tissue obscuring cancer limited its sole application (1).

Breast tomosynthesis is a new technology of digital mammography that enables the acquisition of a three-dimensional volume of thin section data, and thus reduces or eliminates tissue overlap (2). Such ability allows visualization of cancers not apparent by conventional mammography (3) and differentiation between benign and malignant lesions (2).

Breast MR imaging has also become an important and powerful tool in breast imaging (4).

MRI is not influenced by breast density. Therefore, it may help to characterize the lesion (5), and provide valuable information about breast cancer (4).

After a very promising start of MR of the breast in the clinical practice, a variety of difficulties and obstacles were identified, for example: the lack of standardization of image acquisition, paucity of MR-compatible interventional devices, and the debate about its specificity and positive predictive value, and also its sensitivity for ductal carcinoma in situ (6).

The purpose of this study was to assess the role of 3-D breast tomosynthesis in the confirmation/exclusion of breast lesions detected on inconclusive digital mammogram and since tomosynthesis is a multislice modality, we evaluated its impact on characterization and consequently diagnosis whether benign or malignant in comparison with MR mammography.

2. Patients and methods

This study is a retrospective analysis approved by the Ethics Committee in Wadi El-Neel Hospital and waiver of informed consent was applied for the used data of the included cases.

The study started at January 2013 till June 2014 included 98 patients with 103 breast lesions. Patients' age ranged from 25 to 81 years with a mean of 48.6.

2.1. Patients

Ninety-eight patients were referred from the outpatient clinics of both General Surgery and Oncology (after having clinical breast examination) to the Radiology Department of our institution.

Our inclusion criteria were as follows:

- The presence of palpable lump detected by clinical breast examination in mammograms of heterogeneously and extremely dense breasts (ACR "c" and "d").
- Mammograms of inconclusive pathology discrimination (i.e. BI-RADS 3 and 4 category).

Exclusion criteria were as follows:

- Diagnostic mammograms with distinct BI-RADS category whether benign or malignant: (i) BI-RADS 2 that showed rounded masses with macrocalcifications; scattered macro- or microcalcifications and masses or densities with fat radio-lucency within. (ii) BI-RADS 5 that showed spiculated masses with or without microcalcifications.
- Contraindication of MR examination: pacemaker, aneurysm clip, or the presence of metallic foreign body in or near the eye, ear or teeth.
- Patients with renal impairment (eGFR > 30 ml /min/1.73 m^2), being contraindicated to contrast injection.

2.2. Methods

Cases were assessed by bilateral DM, DBT and MRM.

A complementary ultrasound examination performed for all cases using both B-mode and elastography ultrasound on Aplio XG device (Toshiba, Japan) to confirm or exclude mammography identified abnormalities. Examination was done by 6–9 MHz high frequency probe.

2.2.1. Mammography examination

A combined full field DM and 3D tomosynthesis examinations were done using Hologic Selenia Dimensions Digital Tomosynthesis System using the following steps:

- *Position views:* Images of both breasts are taken in the cranio-caudal and mediolateral oblique views.
- *Acquisition:* The system attains a "Combo-mode" imaging technique (2D + 3D imaging) that acquires a traditional digital mammogram and a tomosynthesis scan in the same compression. During a tomosynthesis scan, multiple (7–11), low-dose images of the breast are acquired at different angles while the X-ray tube moves in an arc across the breast. These images are then used to produce a series of one-millimeter thick images (from 60 to 90 slices, according to the breast size) that can be reconstructed to a three dimensional image of the breast.
- *Display methodology:* Images are displayed on dedicated high resolution workstations with special capabilities that are tailored for breast imaging. The re-constructed tomosynthesis images can be viewed as one slice at a time or in a cine loop.

2.2.2. Magnetic resonance imaging

Examinations were performed on "Panorama" 1.0T open MR system, with an image quality equivalent to that of a 1.5 T cylindrical system (Philips Medical Systems, Netherlands.). We used bilateral breast surface coil and the patient was in the prone position.

Total study time ranged from 30 to 45 min.

The routine MR imaging examination included the following:

A-Localizer scout views in the sagittal orientations.

B-Pre-contrast series: axial T1-weighted turbo spin echo (TR/TE = 418/10 ms), axial T2-weighted turbo spin echo (TR/TE = 4.8 s /120 ms) and axial short tau inversion recovery (STIR) (TR/TE = 6.5 s /80 ms; inversion time = 150 ms) as well as sagittal T2 turbo spin echo weighted sequences. Slice thickness = 4 mm, matrix = 512 × 192, FOV = 340–370 mm.

C-Post-contrast series: Seven dynamic acquisitions, one before and six after intravenous injection 0.1 mmol/kg body