The Role of Dual Energy Contrast Mammography in Improvement of the Accuracy of Sonomammography in Evaluation of Breast Lesions

Thesis

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بسم الله الرحمن الرحيم

"قَالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ"

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LIST OF ABBREVIATIONS

2D	Two –dimensional
3D	Three-dimensional
ACR	American College of Radiology
BI-RADS	Breast Imaging Reporting and Data System
CC	Craniocaudal
CEDM	Contrast-enhanced digital mammography
CT	Computed tomography
DCIS	Ductal carcinoma in situ
DBT	Digital breast tomosynthesis
FFDM	full-field digital mammography
Gd	Gadopentetate dimeglumine
IDC	Invasive Ductal Carcinoma
ILC	Invasive Lobular Carcinoma
LCIS	Lobular carcinoma in situ
MIP	Maximum intensity projection
MLO	Medio-lateral oblique
MRI	Magnetic resonance imaging
MRA	Magnetic resonance angiography
MX	Mammography
NCI	National Cancer Institute
ROC	Receiver Operating Characteristic Curve
ROI	Region of interest
RT-PCR	Reverse transcriptase polymerase chain reaction
SNR	Signal to noise ratio
TNM	Tumour, nodes, metastases
US	Ultrasonography

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ABSTRACT

Purpose:

The purpose of this study is to assess the role of dual energy contrast mammography in improvement of the accuracy of sonomammography in evaluation of breast lesions.

Material & methods:

34 female patients were enrolled in the study their age ranged between 24-67 years old, mean age is about 49.8. All presented with breast lesion benign and malignant in sono-mammography categorized as BIRADS from 2 to 5.

All were subjected to Dual-energy contrast enhanced digital mammography , Pair of low- and high-energy images were acquired after contrast injection using a modified full-field digital mammography system , then the two images were combined to enhance areas of contrast uptake. The nonionic iodinated contrast agent was administered manually into the contralateral antecubital vein manually .

The results were compared to the sono-mammography and cases were histopathologically proven.

Results : 28 /34 of our cases were histopathologically proven as malignant and 6/34 were benign. An area of enhancement was depicted on contrast-enhanced digital mammograms (CEDM) in all histologically proven breast carcinomas, compared to 24/28 by ultrasound sonomammography and 20/28 by conventional mammography alone. Our results show that sensitivity was higher for MX+CEDM (70.8 % and 78%) than that was for ultrasound alone (69.9 and 64.3%) or for mammography alone (52.9% and 62.5 %) compared to pathology and BIRADS analysis respectively with no

loss in specificity. Also the good diagnostic accuracy of CEDM+ MX for the detection of breast carcinoma, which here superior to mammography alone and to ultrasound alone or combined both mammogram with ultrasound. Role of DECM was superior in about 70.6 % of cases compared to 20.6 % to that of ultrasound alone, and no difference with adding DECM to conventional sonomammography in 8.8 % of cases. Also accuracy of diagnosis by adding CEDM increased in about 76.5 of cases versus only 23.5 % of cases show no difference in accuracy increase using the conventional sonomammography. Compared with mammography associated with breast ultrasound, CEDM had a better diagnostic accuracy mainly due to improved specificity, and better positive and negative predictive values (**Positive predictive value about 91.3, negative predictive value 36.5 %).**

Conclusion: The addition of dual energy contrast enhanced mammography technique to Conventional sonomammography can significantly improve diagnostic quality and the cancer detection rate.

Key word: DECM-SNR-CC-Sonomammography-CEDM

Introduction

AIM OF THE WORK

Background

Breast cancer is one of the most common types of cancer. Despite advances in mammography, at least one in four malignant tumors remains undetected using screening mammography alone [***Pisano ED et al 2005***]. In dense breast tissue, more than half go undetected [***Pisano ED et al 2005***, ***Pisano ED et al 2008***].

Although mammography is a well-established, cost-effective imaging technique for breast cancer detection [***Pisano ED et al 2005– Kuhl C 2007***], it has limitations, particularly in dense [***Peters NHGM et al, 2008***] and treated breasts. Ultrasound is a complementary technique to mammography, especially for dense breasts and is part of the standard of care in diagnostic procedures [***Jong RA,et al 2003***].

Contrast-enhanced breast imaging techniques (like CT and MRI) are used for detection of angiogenesis by tracking contrast agent up-take and wash-out in tissues. Even if reported to be useful in the detection of breast carcinoma, CT (computed tomography) has the drawback of high radiation dose levels [***Dromain C, et al 2006***]. Contrast-enhanced MRI seems to be currently the most sensitive breast cancer detection technique, but have high false positive rate and still carries the burden of higher costs and lower availability. Taking advantage of the inherent capabilities of image processing in digital mammography, advanced applications may bring

additional clinical and cost benefits to the current standard of care [***Diekmann F, et al 2007***].

Among these applications, contrast-enhanced digital mammography (CEDM) may specifically open the door to detection of angiogenesis in the mammography suite. Clinical feasibility and initial experiences with CEDM have been reported for two techniques: temporal subtraction and dual energy [***Lewin JM et al,2003,Clarisse Dromain et al 2011***].

AIM OF WORK

This work presents the initial clinical performance results of the role of dual-energy CEDM in improving the accuracy of conventional sonomammography as an adjunct to mammography (MX) versus MX alone and versus MX+ ultrasound (US).

Review of Literature

NORMAL BREAST ANATOMY

The female breast takes variable shapes and dimensions. The average breast measures 10 to 12 cm in diameter and its average thickness centrally is 5 to 7 cm. The contour of the breast varies but is usually dome-like, with a conical configuration in the nulliparous woman and a pendulous contour in the parous woman. ***[Osborne MP, 2000]***

The breast is anterior to the deep pectoral fascia and is normally separated from it by the retromammary space. The breast extends laterally from the lateral edge of the sternum to the mid-axillary line and from the second rib superiorly to the sixth rib inferiorly. An axillary tail (of Spence) extends toward the axilla, or armpit. ***[Osborne MP, 2000] (Fig. 1 and 2)***

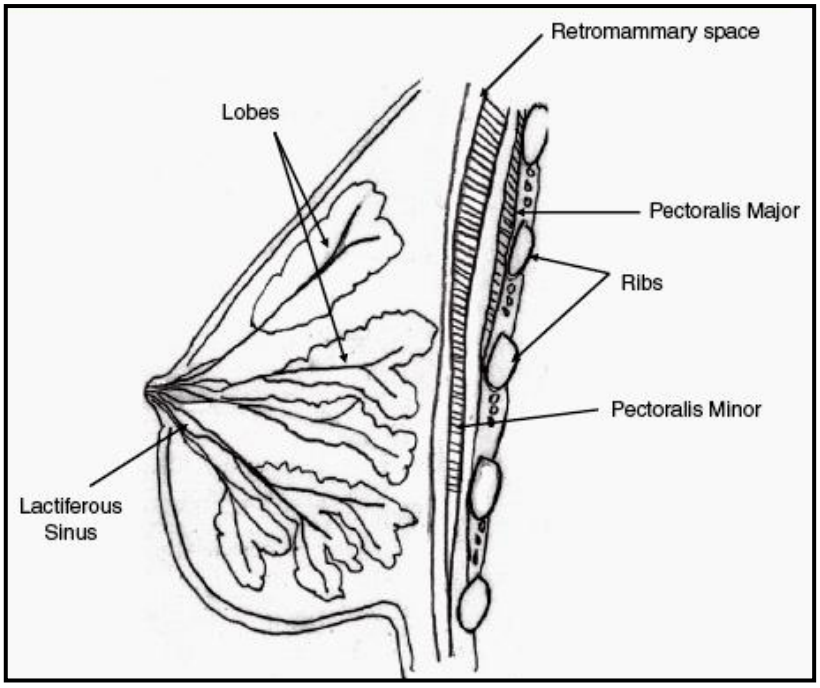

Figure 1.1
*Sagittal section through the lactating breast****[Osborne MP, 2000].***