ROLE OF AUTOMATED BREAST ULTRASOUND SYSTEM (ABUS) AS SCREENING TOOL IN COMPARISON TO MAMMOGRAM IN DETECT DIFFERENT BREAST LESIONS

Thesis

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Marwan Ashraf Mohammed

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List of Abbreviations

Abb.	Full term
ABUS	Automated breast ultrasound system
ACC	Acini Cell Carcinoma
ACR	American College of Radiology
ACS	American Cancer Society
ALH	Atypical Lobular Hyperplasia
AMC	Atypical Medullary Carcinomas
BCSC	Breast Cancer Surveillance Consortium
BIRADS	Breast Imaging And Reporting Data System
CC	Cranio-caudal
CESM	Contrast Enhanced Spectral Mammography.
CI	Confidence interval
CISNET	Cancer Intervention Surveillance Network
DBT	Digital Breast Tomosynthesis.
DCIS	Ductal Carcinoma Insitu
DM	Digital Mammography
DMIST	Digital Mammography Imaging Screening Trials
FFDM	Full Field Digital Mammography
GCDFP-15	15-kDa Glycoprotein Of Cystic Breast Disease
IBC	Inflammatory Breast Cancer
ICC	Invasive Cribriform Carcinoma
IDC-NST	Invasive Ductal Cardnomas No Spedal Type
IFLSpCC	Fibromatosis-Like Spindle-Cell Metaplastic
ILC	Invasive Lobular Carcinoma
IMPC	Invasive Micropapillary Carcinoma
LCIS	Lobular Carcinoma Insitu
LGAS	Low-Grade Adeno-squamous Carcinoma
LN	Lobular Neoplasia
MBC	Metaplastic Breast Carcinomas
MC	Medullary Carcinoma
MD	Mammographic Density
MEC	Mucoepidermoid carcinoma

List of Abbreviations Cont...

Abb.	Full term
MLO	Medio-lateral Oblique
MRI	Magnetic Resonance Imaging
NE	Neuroendocrine
NST	No Special Type
OC	Oncocytic Carcinoma
OGCs	Osteoclast-like Stromal Giant Cells
PLCIS	Pleomorphic Lobular Cardnoma Insitu
RCTs	Randomized Controlled Trials
RRR	Relative risk ratio
SC	Sebaceous Carcinoma
SCBC	Spindle Cell Breast Carcinoma
SCC	Squamous Cell Carcinoma
SRCC	Signet Ring Cell Carcinoma
TC	Tubular Carcinoma
TFDs	Thin Film Diodes
TFTs	Thin Film Transistors
TLDU	Terminal Ductal Lobular Unit
TN	Triple Negative
US	Ultrasound

Abstract

Background: Mammography is an effective randomized controlled trial-proven method for reducing mortality due to breast cancer. However, the sensitivity of mammography depends on breast density. The current supplemental screening options include breast ultrasonography (US) and magnetic resonance imaging (MRI). Automated breast ultrasound system (ABUS) is an option proposed to overcome the time-consuming and costly nature of handheld, physician-performed whole-breast US (WBUS).

Objectives: To evaluate the utility of automated breast ultrasound system (ABUS) in detection of different breast lesions especially in dense breast in comparison to mammogram.

Patients and Method: It is prospective study included 25 women outreached for digital mammography or handheld ultrasound examination at the general Egyptian hospitals. Women have no specific age group.

Results: We found, statistically, the use of ABUS alone without the mammogram shows insignificant results difference while using ABUS with mammogram shows increased frequency of detection of positive benign lesions in ACR class C and D in comparison to class A and B.

Conclusion: ABUS is a computer-based system for performing and recording ultrasound of the entire breast. The use of ABUS with mammography improved the accuracy of breast lesions detection (especially benign lesions), callback rates, and confidence in callbacks for women with dense breast tissue. In conclusion, ABUS reflects a promising modality in breast imaging however appears to be on a par with hand-held ultrasound in terms of diagnostic quality.

INTRODUCTION

Mammography is an effective randomized controlled trial-proven method for reducing mortality due to breast cancer. A recent study showed 43% reduction among women participating in a national screening program. However, the sensitivity of mammography depends on breast density. Studies on women with dense breasts have demonstrated a sensitivity of less than 50%. More recently, more than 50% of women younger than 50 years and at least one-third aged over 50 years have been found to have dense breast tissue. The current supplemental screening options include breast ultrasonography (US) and magnetic resonance imaging (MRI). US-based screening technologies may offer lower cost and wider availability than MRI. However, bilateral whole-breast screening using handheld US (HHUS) is time consuming, operator dependence, non-reproducibility, and time required by the radiologist to perform the exams. ABUS screening is an option proposed to overcome the time-consuming and costly nature of handheld, physician-performed whole-breast US (WBUS) ***(Shin et al., 2015).***

Both ABUS and handheld ultrasound exhibited high sensitivity (both 100%) and average specificity ***(Jianwei et al., 2012).***

Dense breast tissue obscures tumors on mammograms, making it difficult for radiologists to read and interpret the

exams. This inaccuracy has resulted in an increased number of false positives and biopsies, and has increased healthcare costs and patient anxiety. For this reason recently, research and development in ultrasound are demonstrating that it is a technology that can lend itself to breast diagnostic imaging. Automated Breast Ultrasound an alternative to traditional hand-held ultrasounds for supplemental use. Like traditional ultrasound, ABUS uses high-frequency sound waves targeted at the breast, but the scans provide physicians with a 3-D volumetric image of the entire breast. These 3-D images are more beneficial to women within the dense breast population because they allow radiologists the ability to check the breast from a variety of angles and offer a better interpretation. ABUS exams are also much shorter than traditional ultrasound, with some systems taking as little as seven minutes to perform a bilateral exam — less than half the time of some traditional ultrasounds. Because the transducer used in ABUS automatically scans the breast, the operator dependency is greatly reduced ***(Jacob, 2012).***

REVIEW OF LITERATURE

Clinical breast examination

Clinical breast examination by a health care provider has been studied as a screening method used in conjunction with mammography and ultrasound. In the Canadian National Breast Screening Study of women age 50 to 59 years receiving either mammography and clinical breast examination or only clinical breast examination, the 25-year cumulative mortality from breast cancer diagnosed during the screening period was essentially equivalent between women who received mammography and clinical breast examination versus women who received only clinical breast examination ***(Miller et al., 2014).***

Of note, the clinical breast examinations were performed by well-trained clinicians, the quality of the clinical breast examinations were evaluated periodically, and the clinicians spent 5 to 10 minutes examining each breast ***(Mackenzie et al., 2015).***

Community clinicians may not perform such high-quality clinical breast examinations, limiting the applicability of these results to general practice ***(Mackenzie et al., 2015).***

Mammography

Mammography is specialized medical imaging that uses a low-dose x-ray system to see inside the breasts. A mammography exam, called a mammogram, aids in the early

detection and diagnosis of breast diseases in women. A mammography unit is a rectangular box that houses the tube in which x-rays are produced. The unit is used exclusively for x-ray exams of the breast, with special accessories that allow only the breast to be exposed to the x-rays. Attached to the unit is a device that holds and compresses the breast and positions it so images can be obtained at different angles ***(ACR practice guidelines, 2013).***

Mammograms are used as a screening tool to detect early breast lesions specially breast cancer in women experiencing no symptoms (Screening mammogram). They can also be used to detect and diagnose breast disease in women experiencing symptoms such as a lump, pain, skin dimpling or nipple discharge (Diagnostic mammogram) ***(ACR practice guidelines 2013).***

Image quality: *(ACR practice guidelines, 2013).*

Criteria (or image quality assessment):

- All breast glandular tissue imaged
- Image annotation:
  - Date
  - Patient ID
  - Side markers
  - Radiographer ID

- Cassette lD

- Correct exposure- can "bright light" skin and nipple
- No movement artifact
- No skin folds
- Symmetrical images

Adequate cranio-caudal views:

- All glandular tissue identified
- Nipple in profile.
- Nipple in midline of image
- Images symmetric.

Adequate medio-lateral oblique views:

- Pectoral shadow seen down to level of nipple or lower
- Infra-mammary fold well seen
- Nipple in profile
- Images symmetric

Digital Mammography, also called full-field Digital Mammography (FFDM), is a mammography system in which the x-ray film is replaced by electronics that convert x-rays into mammographic pictures of the breast. These systems are similar to those found in digital cameras and their efficiency