Cost-Benefit relationship between Hand Held Ultra-Sound (HHUS) and Automated Breast Ultra-Sound (ABUS) as a complementary scan for Mammography in detection of breast lesions

A Thesis

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Esraa Elsayed Moustafa

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List of Abbreviations

Abbr.		Full-term
ABUS	**:**	Automated breast ultrasound
ACR	**:**	Breast density according to American College of Radiology
BBD	**:**	Benign breast diseases
BIRADS	**:**	Breast imaging reporting and data systen
CC	**:**	Cranio-caudal
CI	**:**	Confidence interval
DCIS	**:**	Ductal carcinoma in situ
HHUS	**:**	Handheld ultrasound
IDC	**:**	Invasive Ductal Carcinoma
ILC	**:**	Invasive Lobular Carcinoma
LCIS	**:**	Lobular carcinoma insitu
MLO	**:**	Mediolateral oplique
SD	**:**	Standard deviation

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Abstract

Aim of the Work: to compare between HHUS and 3D ABUS, according to their benefits and limitations as a complementary scan for mammography in detection of breast lesions.

Patients and Methods: The study was conducted on 30 female patients with breast masses diagnosed by clinical examination or by sonomammography in Radiology Department at Al Sheikh Zayed Aal Nahian hospital and Ain Shams University Hospitals during the period from October 2018 and August 2019. Findings were confirmed by histopathological biopsy or at least 6 months follow up.

Results: Statistically significant difference between ABUS and HHUS time of examination in favor of ABUS with P-value <0.0001 and 95%CI-5.7:-4.4, as ABUS time of examination was (mean+/- SD: 4.1 +/-0.9) and HHUS was (mean +/- SD: 9.2 +/-2.0). In this study; 8 out of 30 were malignant lesions and 22 were benign findings. HHUS showed higher sensitivity than ABUS (100% versus 88%); specificity (86%, 91%), positive predictive value (73%, 78%) and negative predictive value (100%, 95%) respectively. HHUS and ABUS shows nearly perfect agreement regarding lesion classification(benign &malignant).with Cohen's kappa (κ) 0.85, and also regarding BIRADS classification With Weighted kappa 0.824.

Conclusion: There is a near perfect agreement between ABUS and HHUS diagnostic performance (κ) 0.85,and statistically significant difference in time of examination in favor of ABUS as it is operator independent and provide large scanned area in every single sweep and also aided with computer software, but HHUS still have higher sensitivity than ABUS and that may be attributed to ABUS limitations to evaluate axillary lymph nodes and lack of Doppler, so ABUS may serve as an effective, adjunct, screening tool to mammography and hand held Sonography.

Key word: Cost-Benefit relationship, Hand Held Ultra-Sound, Automated Breast Ultra-Sound, Mammography, breast lesions

Introduction

Breast cancer in women is a major public health problem throughout the world. It is the most common cancer among women both in developed and developing countries. Mammography has low sensitivity and specificity in women with radiographically dense breast.

Although Mammography is considered the cornerstone examination in breast cancer Screening, its low sensitivity in women with dense breasts, is considered as a limitation **(Vourtsis and Kachulis, 2018)** which needs complementary scan to improve rate of detection of any breast masses.

In 1951,when Hand Held Ultrasound (HHUS) was first used, it provided coverage of the underperformance of mammography in dense breast which leads to better breast masses screening and increasing breast cancer detection rate (**Kreienberg et al., 2008**) (**Lee et al., 2010)**.

By clinical use and although HHUS has upper hand over mammography, it shows some defect performing points as: lack of standardization, dependence of personal experience and time consuming with small field of view. So a new scanner device is designed to overcome these defects.

Automated 3D Breast US (ABUS) came as a new scanner, **(Van Zelst et al., 2015)** which is providing automation, no need for well-trained physician to apply it as it is automatically applied under control of technician then volumes are read on workstation by more than one doctor (**Golatta, Michael et al., 2013**).

Also ABUS is providing 3D reconstruction of volumes for better breast anatomy assessment, good observation of lesion margin, speculations and anatomical relations. It is designed with wide linear transducer providing large scanned area in each separate volume as it cover the whole breast scan in three to five separate volume according to breast size **(Wojcinski et al., 2011) (Tozaki et al., 2010).**

Aim of the study

The aim of this study is to compare between Hand Held Ultrasound (HHUS) and 3D automated breast ultrasound (ABUS), according to their benefits and limitations as a complementary scan for mammography in detection of breast lesions.

Chapter (1)
Anatomy of Female Breast

According to **De Benedetto et al (2016),** the breast is a symmetrical organ located on the front of the chest on both sides of the midline (from 3rd to 7th rib).The volume, shape and degree of development are very variable in relation to age, gland development, amount of fat and relative influence of endocrine stimulation.

Nipple and surrounding flat hyper-pigmented area of skin (areola) represent the breast center with variable diameter.

The mammary gland is made of three components: glandular, adipose and fibrous tissues;

The glandular structure: is consisted of 15-20 lobes arranged in an irregular radial pattern around and behind the nipple, each lobe forms an independent glandular structure consisted of numerous lobules, constituted by alveoli, which are the secreting units. The alveolar ducts gather into the lobular ducts which in turn converge into the milk ducts.The milk ducts, then, converge to the nipple with an ampullary dilatation which is known as the lactiferous sinus.

The stroma is composed of **dense fibrous and adipose tissues** that surround the entire gland and penetrate between the lobes. It may be divided in three portions:

1- Subcutaneous part that lies between the skin and the gland.
2- An intraparenchymal portion, located between lobes and lobules.
3- Retromammary portion, located behind the gland.

A two-layer fold of the subcutaneous superficial fascia envelope the breast parenchyma.it may be splited in two portions: the superficial one that covers the glands and contains fibrous septa called Cooper's ligaments, which penetrate the gland and form the support structure of the parenchyma, and the deep one, which covers the posterior portion of the glands and separates it from the underlying superficial fascia of the pectoralis major muscle. Cooper's ligaments are the suspensory ligaments of the breast gland and divide the parenchyma into lobes.

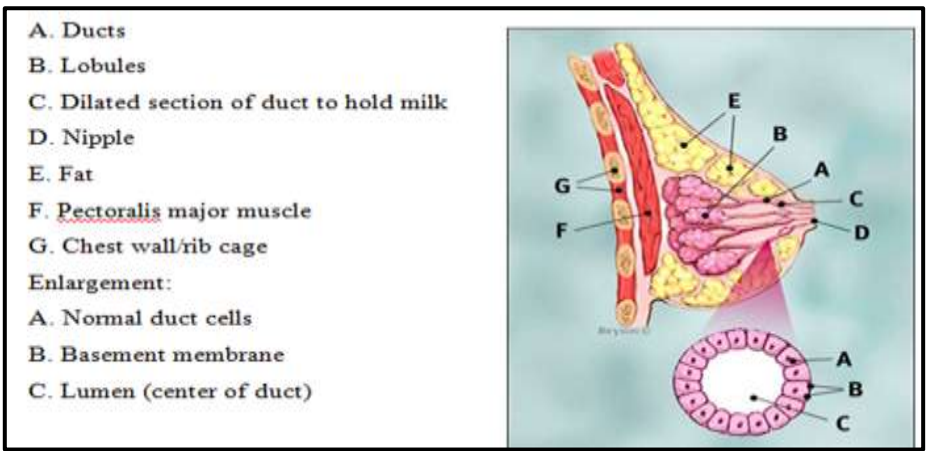

Figure (1): Represents Breast profile **(Dimri et al., 2005)**