



Breast Cancer Detection Using Automated Breast Ultrasound in Mammographically Dense Breasts

Thesis

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By

Latifa Essam Ramzy Gad

M.B.B.Ch, Faculty of Medicine, Ain Shams University

Under Supervisors

Prof. Dr. Sherine Kadry Amin

Professor of Radiodiagnosis
Faculty of Medicine – Ain Shams University

Dr. Mohamed Gamal El Din Abdel Mutaleb

Assistant Professor of Radiodiagnosis
Faculty of Medicine – Ain Shams University

**Faculty of Medicine
Ain Shams University
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

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List of Abbreviations

ABUS	: Automated breast ultrasound
ABVS	: Automated Breast Volume Sonography
ACR's	: American College of Radiology's
BI-RADS	: Breast Imaging Reporting and Data System
DCIS	: Ductal carcinoma in situ
FDA	: Food and Drug Administration
FFDM	: Full-field digital mammography
HHUS	: Hand held ultrasound
HMW	: High molecular weight
HRT	: Hormone replacement therapy
ILC	: Invasive lobular carcinoma
LCIS	: Lobular carcinoma in situ
MC	: Medullary carcinoma
NOS	: Not otherwise specified
NST	: No special type
RR	: Relative risk
SEER	: Surveillance, Epidemiology, and End Results
TDLU	: Terminal Duct Lobular Unit
US	: Ultrasound

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INTRODUCTION

Breast cancer is the most commonly diagnosed malignancy in women worldwide and is the second leading cause of cancer death in women in the United States. Early detection of breast cancer improves outcomes. Screening strategies for detecting early stage breast cancer are now stratified (**Rachel et al., 2015**).

Mammography has been proven in randomized controlled trials to be a sensitive screening tool for the detection of early breast cancer. The reported sensitivity of screening mammography varies from 65% to 91% (**Crystal et al., 2003**).

The performance of mammography is reduced for cancer detection in dense-breasted women as mammograms are summation images, with all breast tissue overlapping in each view. Cancers may not be visualized because of overlying dense breast tissue. Mammography can miss far posterior cancers in the retro-mammary space because of inadequate positioning of deep tissue (**Kelly et al., 2010**).

Ultrasonography is currently considered the first-line examination in the detection and characterization of

breast lesions including the evaluation of breast cancer. In spite of mammography consider as the primary method for screening especially the noteworthy ability of microcalcifications detection. US is good in mass or mass-like lesion detection, especially in the dense breast population (**Pan, 2016**).

Like traditional ultrasound, automated breast 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 give radiologists the ability to check the breast from a variety of angles and offer a better interpretation (**Nyanue, 2013**).

Automated Breast Ultrasound System is a comfortable, non-ionizing alternative to other supplemental screening options for women with dense breast tissue. When used in addition to mammography, ABUS can improve breast cancer detection by 55 percent over mammography alone (**Barclay, 2016**).

AIM OF THE STUDY

The aim of work is to detect the impact of ABUS technique's advantages, pearls and pitfalls combining with mammography compared with mammography alone, significantly improved detection of breast cancers in women with dense breast tissue without substantially affecting specificity.

ANATOMY OF THE BREAST

Mammary glands are a modified and highly specialized type of sweat gland. At the fifth or sixth week of fetal development, ventral bands of thickened ectoderm, the mammary ridges, are evident in the embryo. The mammary ridges through development extend from the axillary to the inguinal regions **(Brunicardi et al., 2004)**.

Mammary buds begin to develop as solid downgrowths of the epidermis into the underlying mesenchyme **(Drew et al., 2007)**.

The primary bud is formed as a result of in growth of the ectoderm, leading to development of each breast. The primary bud leads to development of 15 to 20 secondary buds that develop into lactiferous ducts and their branches. Major lactiferous ducts develop, opening into a shallow mammary pit, which during infancy transform into a nipple. At birth the nipple is inverted and elevates above the skin during childhood. If this elevation does not occur, it gives rise to an inverted nipple **(Moore et al., 1998)**.

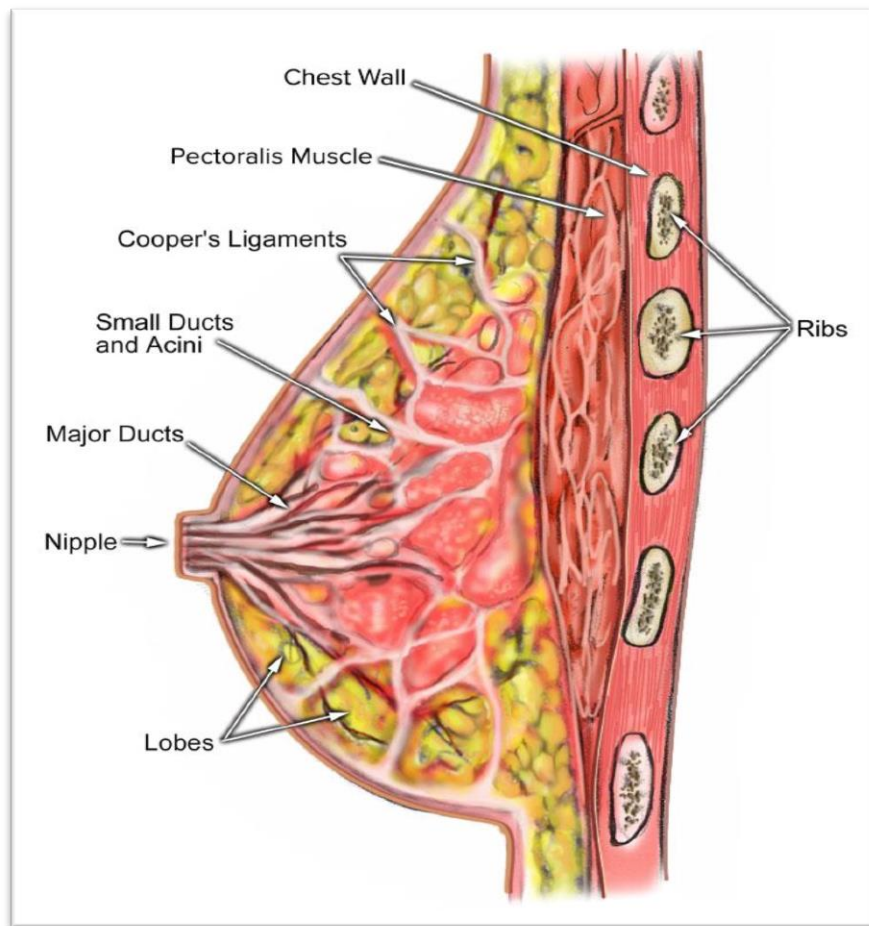


Fig. 1: Sagittal section through the female breast and anterior thoracic wall (**Gabriel et al., 2016**).

The mature human breast is composed of skin and subcutaneous tissue, breast parenchyma (ducts and lobules), and supporting stroma, including fat interposed in a complex network of ligaments, nerves, arteries and veins, and lymphatics. In both men and women, the borders of the breast typically extend from the second rib

superiorly to the sixth rib inferiorly with the sternum medially and the mid axillary line laterally (**Jesinger, 2017**).

The breast tissue lies in the superficial fascia just deep to the dermis. It is attached to the skin by the suspensory ligaments of Cooper and is separated from the investing fascia of the pectoralis major muscle by the retro-mammary bursa. The retro-mammary bursa or space is filled with loose areolar tissue, and along with the suspensory ligaments of Cooper allows the breast to move freely against the thoracic wall (**Bland et al., 2009**).

Superficial Fascia:

The superficial fascia of the anterior chest wall is the home of the breast. The fascia completely envelops the lobes of this organ; each breast is formed by 15–20 lobes of glandular tissue. The lobes and lobules are separated by connective tissue, the septa. The subcutaneous tissue is thin or thick and travels deeply, forming the septa. Adipose tissue is also present between the lobes (**Bland, 2009**).

Deep Fascia:

The deep fascia, known as the deep pectoral fascia, envelops the pectoralis major muscle and travels below with the deep abdominal fascia. The deep fascia also attaches medially to the sternum and laterally and above to the clavicle and axillary fascia (Fig.1). Along the lateral border of the pectoralis major muscle, the anterior lamina of the deep pectoral fascia unites with the fascia of the pectoralis minor muscle and more inferiorly with the fascia of the serratus anterior (**John, 2009**).

Axilla:

The axilla is the home of the nerves and vessels of the upper extremity. These are enveloped by a fascia, the axillary sheath, which is a continuation of the prevertebral fascia of the route of the neck. The axilla also contains lymph nodes, adipose tissue, the tendons of the long and short heads of the biceps, and various fasciae (e.g., pectoral, clavipectoral). The axilla is located between the upper extremity and the thoracic wall. By definition, it is pyramidal, with an apex, a base, and four walls. The apex is a triangular space that extends into the posterior triangle of the neck by an opening (the cervico-axillary