# بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / سلوي محمود عقل

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

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# Assessment of Indeterminate Breast lesions (BIRADS 4): Utility of Contrast Enhanced Mammography

*Thesis*

*Submitted for Partial Fulfillment of MD Degree in Radiodiagnosis*

*By*

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# List of Abbreviations

| Abb. | Full term |
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| **2D** | Two dimensional |
| **ACR** | American college of Radiology |
| **BIRADS** | Breast Imaging Reporting and Data System |
| **CC** | Craniocaudal |
| **CEDM** | Contrast enhanced dual energy mammography |
| **CEM** | Contrast enhanced mammography |
| **CESM** | Contrast enhanced spectral mammography |
| **CFN** | Centimeters from the nipple |
| **CIN** | Contrast induced nephropathy |
| **CT** | Computed Tomography |
| **FFDM** | Full field digital mammography |
| **HE** | High energy imaging |
| **kVp** | Kilo voltage |
| **LE** | Low energy imaging |
| **MLO** | Mediolateral oblique |
| **MRI** | Magnetic Resonance Imaging |
| **NME** | Non-mass enhancement |
| **UOQ** | Upper outer quadrant |
| **US guided** | Ultrasound guided |

# INTRODUCTION

Breast cancer is the most common cancer in women across the world. Between 2008 and 2012, worldwide breast cancer incidence rates have increased 20% and mortality rates have increased 14% ***(Luczynska et al., 2015).*** In Egypt, breast cancer is estimated to be the most common cancer among females accounting for 37.7% of their total and is also the leading cause of death due to cancer, accounting for 29.1% ***(Zeeneldin et al., 2013).***

It is therefore of utmost importance to find an accurate and cost-effective way to detect and diagnose breast cancers in women across different age groups and different economic levels ***(Luczynska et al., 2015).***

Early detection of breast cancer by X-ray mammography screening has been shown to reduce mortality; however, it is limited by moderate sensitivity and specificity especially in dense breasts. To overcome these limitations, further workup of suspicious mammography findings may become necessary, by using additional mammographic views or by ultrasound or by contrast enhanced breast magnetic resonance imaging (MRI) ***(Tabar et al., 2011).***

Ultrasound is a complementary technique to mammography however; manual US examinations are time-consuming, operator dependant and any findings have to be characterized during the procedure with limited possibility of a second independent evaluation of the already captured images ***(Dromain et al., 2011).***

Breast cancers are well known to enhance after the administration of contrast agents, because tumoral microvessels form rapidly and consequently often have 'leaky' basement membranes. This makes the vessels permeable to contrast agent, resulting in tumor enhancement ***(Lobbes et al., 2014).*** Contrast-enhanced breast imaging techniques like CT and MRI are used for the detection of angiogenesis in suspicious tissues. However, CT has the disadvantage of high radiation doses despite its reported use in the detection of breast carcinoma ***(Jochelson et al., 2013).***

Contrast-enhanced MRI is currently the most sensitive breast cancer detection technique, but is costly, not always available and may result in high false positive rates. Also patients with pacemakers, certain aneurysm clips, metal implants or severe claustrophobia are unable to undergo MRI ***(Luczynska et al., 2014).***

Contrast-enhanced mammography (CEM) is a relatively new tool among breast imaging protocols, which combines full field digital mammography (FFDM) with intravenous contrast utilization ***(Daniaux et al., 2015).*** In CEM, a pair of images is acquired for each view: one low-energy image (LE), which is similar to a standard mammogram, and one high-energy image (HE), which is optimized for the detection of iodine contrast agent uptake; the two images are then combined to create an image where glandular tissue is suppressed and contrast uptake is highlighted ***(Fallenberg et al., 2014).***

Since the principal behind Contrast-enhanced mammography is similar to that of breast MRI, it is to be expected that many indications for breast MRI could apply to Contrast-enhanced mammography ***(Lobbes et al., 2013).***

CEM can serve as a valuable tool in the further evaluation of extremely dense breast tissue, in the diagnostic assessment of suspicious lesions, in breast cancer staging, in surgical planning, and in the assessment of treatment response. It can help characterize and guide management particularly when multiple suspicious findings are detected during the initial screening mammogram ***(Bhimani et al., 2017).***

# AIM OF THE WORK

To investigate the usefulness of dual energy contrast enhanced mammography in the assessment of indeterminate breast lesions (BIRADS 4).

# ANATOMY OF THE BREAST

## *Embryology of the Breast*

Mammary glands are a modified and highly specialized type of sweat gland. During the 5$^{th}$ or 6$^{th}$ week of fetal development, two bands of thickened ectoderm, extending from the axillary to the inguinal regions, become apparent. These bands are known as mammary ridges from which mammary buds begin to develop in the form of solid down-growths of epidermis into the underlying mesenchyme. As the human embryo continues to develop, the mammary ridges disappear except for small portions that may persist in the pectoral regions ***(Pandya and Moore, 2011).***

The in-growth of the ectoderm results in the formation of the primary bud which in turn gives rise to 15-20 secondary buds that develop into lactiferous ducts and their branches (**Fig. 1**) At birth, only the main lactiferous ducts have formed and the mammary glands themselves are underdeveloped until puberty ***(Pandya and Moore, 2011).***