# Added Value of Contrast-Enhanced Spectral Mammography in Malignant and Suspicious Breast lesions

*Essay*

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*By*


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**Ereny Tanious**

# List of Contents

# List of Tables

# *List of Figures*

| Fig. No. | Title | Page No. |
|---|---|---|

# List of Figures Cont...

| Fig. No. | Title | Page No. |
|---|---|---|

# List of Figures Cont...

# List of Abbreviations

| Abb. | Full term |
|---|---|
| 2D | Dual energy digital mammography |
| ACR | American college of radiology |
| AJCC | American Joint Committee for Cancer |
| ALH | Atypical lobular hyperplasia |
| BI – RADS | Breast Imaging Reporting and Data System |
| CAP | College of American Pathologists |
| CC | Cranial-Caudal |
| CDEM | Contrast enhanced digital mammography |
| CE2D | Contrast-enhanced dual energy |
| CESM | Contrast-enhanced spectral mammography |
| CsI | Cesium iodide |
| DCIS | Ductal carcinoma in-situ |
| DM | Digital mammography |
| ER | Estrogen receptor |
| FFDM | Full field digital mammography |
| HER2 | Human epidermal growth factor receptor 2 |
| IDC | Invasive Ductal Carcinoma |
| ILC | Invasive Lobular Carcinoma |
| LCIS | Lobular carcinoma in situ |
| LIQ | Lateral inferior quadrant |
| LN | Lymph nodes |
| ML | Mediolateral |
| MLO | Medial lateral oblique |
| MRI | Magnetic resonance imaging |
| OS | Overall survival |
| PR | Progesterone receptor |
| pT1mi | Pathologic T1 tumors |
| pTis | Pathologic tumor in situ |
| TDLU | Terminal ductal-lobular unit |
| TNM | Tumor, lymph node, and metastasis |

# INTRODUCTION

Mammography remains the method of choice for breast imaging, despite the development and improvement of other imaging modalities in recent decades. In the field of mammography too, significant technical improvements were realized, mainly owing to the introduction of digital mammography (DM) ***(Pisano et al., 2005).*** However, even though the diagnostic accuracy of full field digital mammography is good, it depends heavily on breast density ***(Carney et al., 2003).***

Abnormalities become more difficult to detect with increasing breast density, because of the latter's masking effects. It showed that sensitivity of screening mammography in extremely dense breasts was 62.9 %, versus 87.0 % in fatty involution breasts. Specificity was 89.1 % in extremely dense breasts, versus 96.9 % in fatty involution breasts ***(Carney et al., 2003).***

The use of contrast agents in breast imaging, other than in MRI, is not widespread. Several mammographic techniques that use iodine contrast agents have been proposed to improve the visualization of malignant lesions in the breast. It is known that a tumor needs to develop its own blood supply in order to grow beyond a few millimeters in size. This angiogenesis provides a potential method of improving the conspicuity of malignant lesions through differential uptake of contrast agent.

The advantage of full field digital mammography systems has allowed the investigation of some of these techniques for breast imaging ***(Robson, 2010).***

Contrast enhanced spectral mammography is a new method in breast cancer diagnostics. In recent years, Contrast enhanced spectral mammography has developed dramatically and the number of mammography centers where these examinations are performed is gradually increasing. Typically, Contrast enhanced spectral mammography is used for evaluating patients with suspicious focal lesions where conventional mammography and additional ultrasound examinations fail to make a definitive diagnosis ***(Harvey and Bovbjerg, 2004).***

Though Contrast-enhanced MRI seems to be currently the most sensitive breast cancer detection technique, it has high false positive rate and still carries the burden of higher costs and lower availability. On the other hand contrast enhanced spectral mammography has the advantage of being a fast imaging technique with immediate availability in the mammography suite without a new appointment and without loss of time ***(Dromain et al., 2012).***

# Aim of the Work

To assess the added value of diagnostic contrast enhanced spectral mammography, as adjunct to mammography and ultrasound in patients with malignant and suspicious breast lesions.

# NORMAL ANATOMY OF THE BREAST

The great advances achieved in the surgical treatment of breast cancer have made it essential for mastologists to have detailed knowledge of all anatomical features of the breast and its syntopy with the thoracic wall and axillary region ***(Macèa and Fregnani, 2006).***

The breast is a modified skin gland enveloped in fibrous fascia. The superficial pectoral fascia is located just beneath the skin and in the retro-mammary space. The undersurface of the breast lies on the deep pectoral fascia ***(Morris and Liberman, 2005).***

Although there are fascial layers between the breast proper and the pectoralis major muscle, the breast is not completely separate from the pectoralis major muscle, as there are penetrating lymphatics and blood vessels. **(figure1)**

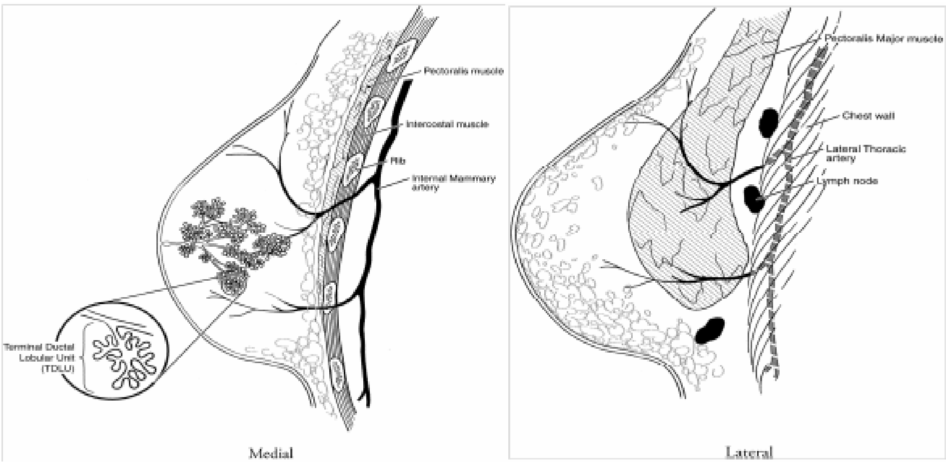



**Figure (1):** Penetrating lymphatics and blood vessels, medially the internal mammary artery and branches are seen; The terminal duct lobular unit (TDLU), Laterally the lateral thoracic artery and branches supply the breast ***(Morris and Liberman, 2005).***

The pectoralis muscles, though attached to the chest wall, are not considered part of the chest wall. This is an important distinction when it comes to staging the patient ***(Morris and Liberman, 2005).***

The breast is composed of three major structures: skin (Normal skin appears smooth and measures usually 0.5- to 2.0-mm thick), except caudally where it may be slightly thicker due to its usual dependency. *(Wilson and Adam, et al 2005),* subcutaneous tissue, and breast tissue (parenchyma and stroma). The parenchyma is composed of lobes that comprise lobules containing 10–100 alveoli that are approximately 0.12 mm in diameter. Each breast lobe is generally considered to exist as a single entity ***(Moffat, 2004). (figure 2)***

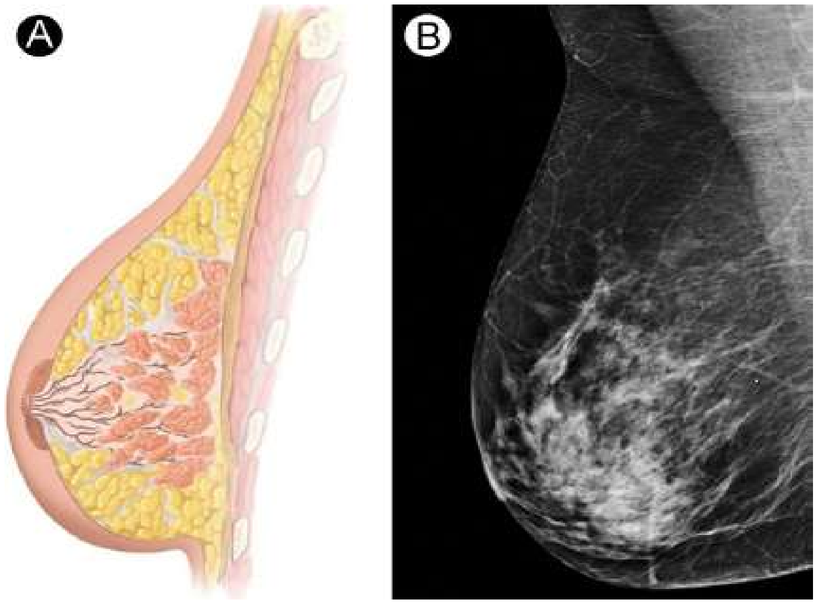
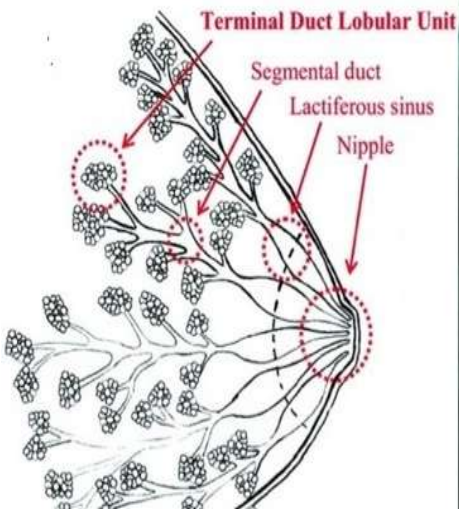



**Figure (2):** Normal female breast anatomy (A-illustrating diagram, B-mammographic image MLO view) ***(Jesinger, 2014).***

Each breast lobe converges into 6-10 major collecting ducts terminating in the nipple and connecting to the outside. The collecting duct arborizes having several branches, which end in a terminal ductal-lobular unit (TDLU), the basic functional and histo-pathological unit of the breast. The TDLU is composed of a small segment of terminal duct and a cluster of ductules, which are the effective secretory units. The functional structures are surrounded by specialized connective tissue. A normal terminal ductal lobular unit ranges from 1-4 mm. The TDLU consists of, extra-lobular terminal duct; intralobular terminal duct and lobule (functional unit of the breast*) (figure 3*) ***(Kopans, 2007).***



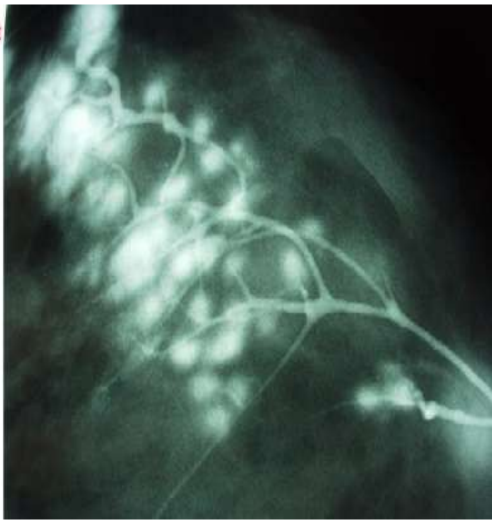



**Figure (3):** Terminal ductal lobular unit (on the right illustrative diagram, on the left ductography) ***(Kopans, 2007).***

The nipple-areolar complex contains the Montgomery glands, large intermediate-stage sebaceous glands that are embryological transitional between sweat glands and mammary glands and are capable of secreting milk ***(Kopans, 2007).*** The Montgomery glands open at the Morgagni tubercles, which are small (1–2-mm-diameter) raised papules on the areola ***(Blech et al., 2004).*** The nipple-areolar complex also contains many sensory nerve endings, smooth muscle, and an abundant lymphatic system called the subareolar or Sappey plexus. Because the skin of the nipple is continuous with the epithelium of the ducts, cancer of the ducts may spread to the nipple ***(Kopans, 2007).***

Breast density, is represented in mammography as the amount of breast parenchyma present in the breast that will be altered as the hormonal environment of the breast changes. Age and fluid status will also alter appearance. Both the epithelial ductal tissue and the surrounding connective tissue elements comprising the parenchyma are affected by the hormonal changes ***(Morris and Liberman, 2005).***

## Breast changes during pregnancy

Pregnancy produces extreme changes in the breast parenchyma with associated vascular engorgement. Early in pregnancy, terminal ducts and lobules grow rapidly with lobular enlargement and depletion in fibro-fatty stroma. Lobular growth continues throughout pregnancy. Following cessation of lactation, involution of the breast occurs over a period of 3 months ***(Morris and Liberman, 2005).***