Sonomammography Versus MRI in Evaluation of BI-RADS III Breast Lesion

Thesis

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Radiodiagnosis

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INTRODUCTION

Breast cancer is the most common cancer in women worldwide, this represents about 12% of all new cancer cases and 25% of all cancers in women **(Savaridas *et al.*, 2015).**

Female breast cancer incidence is strongly related to age, with the highest incidence rates in older women, supporting a link with hormonal status, an average of 80% of breast cancer cases were diagnosed in the over 50s **(Keller *et al.*, 2015).**

The BI-RADS stands for Breast Imaging Reporting and Data System which is a widely accepted risk assessment and quality assurance tool in mammography, ultrasound or MRI, it is classified into six categories:

BI-RADS 0, I and II are toward benign lesions.

BI-RADS III: suspicious abnormality.

BI-RADS IV, V and VI are toward malignancy **(Mann *et al.*, 2014).**

BI-RADS III is an intermediate category in the breast imaging reporting and data system, Findings typical of this category include:

1. Clusters of tiny calcifications if round or oval.
2. Non-calcified solid nodules (no size limitation but non palpable), round, ovoid or well-defined.

3. Selected focal asymmetric areas of fibroglandular density (not palpable).

4. Miscellaneous focal findings, such as a dilated duct, or post biopsy architectural distortion without central density.

5. Generalized distribution in both breasts. For example, multiple similar lesions with tiny calcifications or nodules distributed randomly **(Sippo *et al.*, 2013).**

BI-RADS category 3 lesions are common at screening work up and despite their low malignancy rate, they require additional 3-6 months follow-up and in some scenarios a percutaneous biopsy might be considered, as in extreme patient anxiety, or plans for pregnancy, plans for breast augmentation or reduction surgery **(Percha *et al.*, 2012).**

One should be careful of using BI-RADS III in the postmenopausal breast or a breast that had a previous cancer as fat necrosis, radiation changes and post surgical scarring can change with time **(Bent *et al.*, 2010).**

Mammography is the process of using low-energy X-rays usually around 30kVp to examine the human breast. The goal of mammography is the early detection of breast cancer, typically through detection of characteristic masses and/or microcalcifications **(Kombar *et al.*, 2012).** Adding breast ultrasound to screening mammogram (sonomammography) in women with dense breast and a higher risk of

breast cancer helps to decrease the relatively high false negative diagnosis of breast cancer **(D'souza *et al.*, 2010).**

MRI is a non-invasive imaging technique that uses no compression, X-rays, or radiation. An MRI creates a detailed picture of the internal architecture of breast tissue. Most MRI machines produce a digital image, which a radiologist can examine on a computer, or print out for study. Breast MRI can image both breasts at once, and works well even with dense breast tissue. It is good at finding invasive breast cancer, imaging around breast implants, and detecting possible spread of cancer beyond the primary tumour **(Freer *et al.*, 2015).**

AIM OF THE WORK

To high light the role of sonomammography versus MRI in evaluation of BI-RADS III breast lesion.

ANATOMY OF BREAST

The adult female breast represents a milk-producing gland responsible for lactation, in addition it is one of secondary sexual characteristics **(Shiffman & Giuseppe, 2013)**.

The breast lies on the anterior chest from the second rib superiorly to the sixth rib inferiorly and from the sternal edge medially to the midaxillary line laterally (Figure 1) **(Shiffman & Giuseppe, 2013)**.

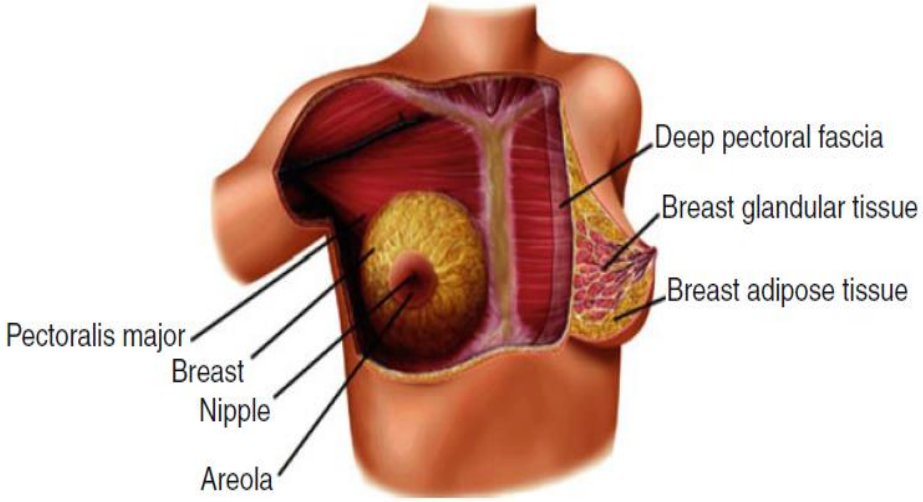

Figure 1: Overview of external and internal breast anatomy **(Shiffman & Giuseppe, 2013)**.

The superficial fascia divides to envelope the breast. Between the two layers of superficial fascia there are cords of connective tissue known as Cooper's ligaments which pass through the parenchyma providing architectural support of the breast. The breast lies on the deep

pectoral fascia which is attached superiorly to the clavicle and sternum, continuous inferiorly with the fascia covering the serratus anterior, rectus abdominis and external oblique muscles, Between the deep layer of superficial fascia and the deep pectoral fascia is a potential space called the retromammary space over which the mammary gland glides and moves **(Shiffman & Giuseppe, 2013)**.

The breast tissue consists of two elements parenchyma and stroma. The parenchymal part contains 15 to 20 lobes, arranged in a radial fashion. Each lobe divides into 20 to 40 lobules. Numerous sac like structures called "acini" form within the lobules at the end of the ducts. The acini produce milk in the lactating breast and involute after lactation. A network of lactiferous ducts drains the acini, lobules and lobes. One major collecting duct drains each lobe. The main collecting duct from each lobe converges radially towards the nipple where they open through tiny openings (Figure 2) **(Morrow & Khan, 2005)**.

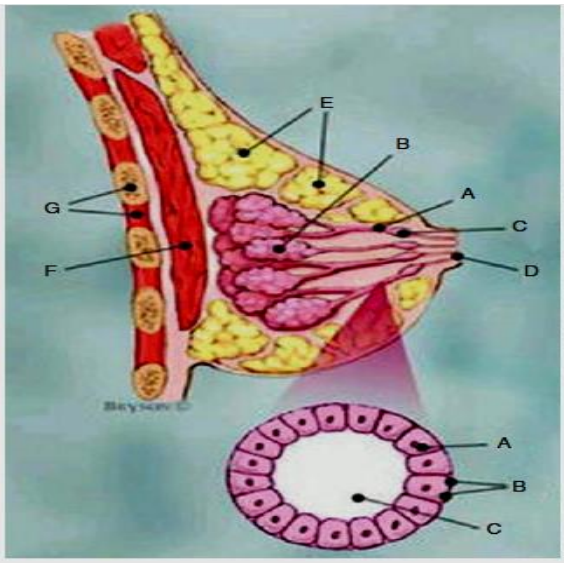

Figure 2: Internal anatomy of the breast. (A) Lactiferous duct, (B) Lobules, (C) Cross section of lactiferous duct, (D) Nipple, (E) Adipose tissue, (F) Pectoralis major muscle, (G) Chest wall/ribs **(Sun *et al.*, 2009)**.

The stroma of the breast consists of loose connective tissue surrounding and supporting the ducts and lobules. Within the stroma a varying amount of adipose tissue is present (Figure 3) **(Javed & Lteif, 2013)**.

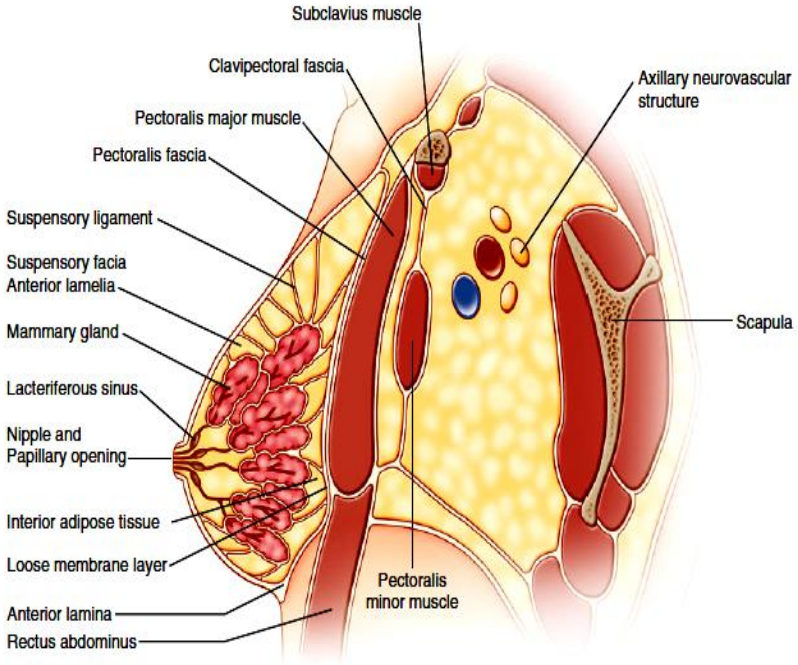

Figure 3: Internal anatomy of the breast **(Kalimuthu *et al.*, 2015)**.

Variations in normal parenchymal patterns:

The amount of fat and glandular tissue in the breast depends on the patient's age, parity and if it is premenopausal or postmenopausal, pregnant or lactating. The prepubertal breast is small and fatty. After puberty, the glandular tissue increases. Around the menopause, parenchymal tissue is present mainly beneath the nipple and in the upper

outer quadrant. The postmenopausal breast shows nearly complete fatty replacement. In pregnant or lactating breast, the expanding glandular tissue fills the breast and duct dilatation may be marked during late pregnancy and lactation. In the menstrual cycle the breast is less dense during the follicular than in the luteal phase so it is optimal for clinical and radiological examination **(Rosen, 2009)**.

Blood supply of the breast:

The vascular supply to the breast is derived from branches of the axillary, internal thoracic and intercostal arteries Figure 4 **(Mugea & Shiffman, 2015)**.

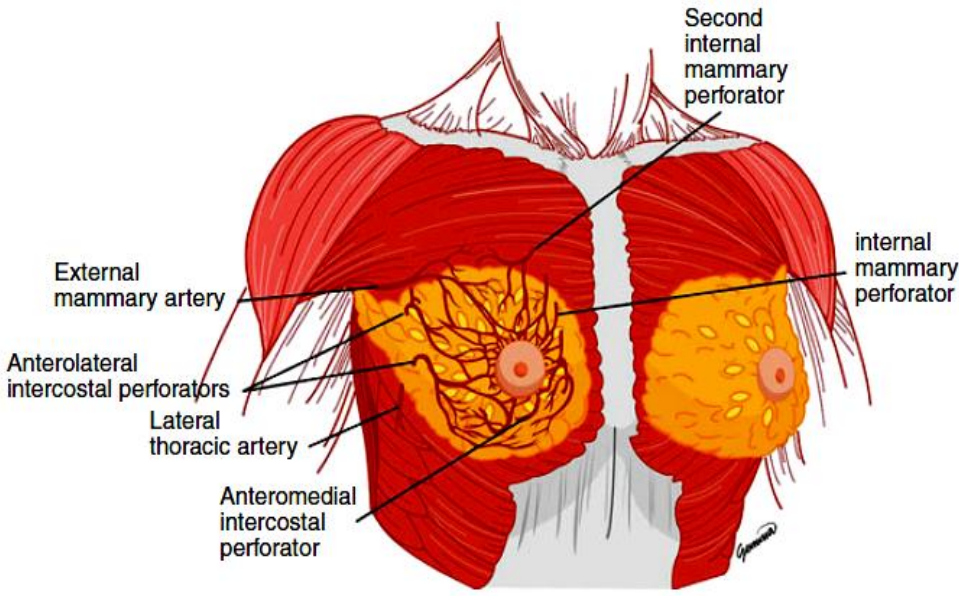

Figure 4: Illustration of vascular supply to the breast **(Mugea & Shiffman, 2015).**

Venous drainage generally corresponds to the arteries, they drain into the internal mammary, axillary, subclavian veins and azygos system via the intercostal veins. The intercostal veins anastomose with the vertebral veins and this route is considered to be responsible for bone metastasis **(Mugea & Shiffman, 2015)**.

Lymphatic drainage

The lymphatic drainage of the breast has an importance in spread of breast cancer. The axillary and the internal mammary nodes are the two main sites for lymphatic drainage of the breast. From the internal mammary nodes, drainage is to mediastinal nodes, paraaortic nodes, bronchomediastinal trunks, and the right thoracic duct **(Urban *et al.*, 2013)**.

The axillary nodes are classified into level I, level II, and level III nodes, depending on their relationship to pectoralis minor as follows:

- The Level I nodes are those found below pectoralis minor.
- Level II nodes lie behind pectoralis minor.
- Level III nodes lie between the upper border of pectoralis minor and lower border of the clavicle (Figure 5) **(Darlington, 2015)**.

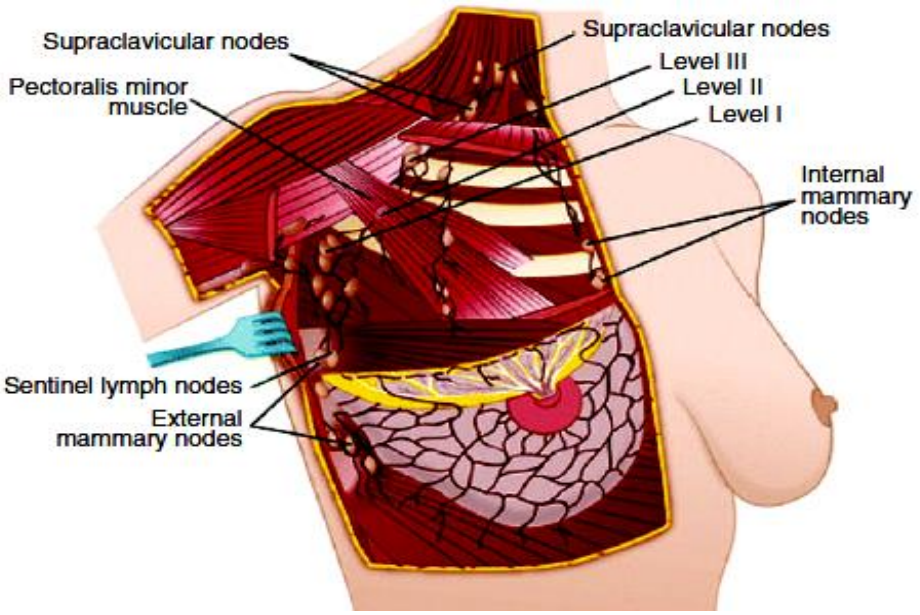

Figure 5: Lymphatic drainage of the breast indicating position of the sentinel lymph node **(Urban *et al.*, 2013)**.

Nerve Supply:

The nerves are from the anterior and lateral cutaneous branches of the fourth to sixth spinal nerves while secretory activities of the gland are controlled by ovarian and pituitary hormones **(Kalimuthu *et al.*, 2015)**.

Normal Mammographic Anatomy:

Fibroglandular tissue appears white,and fat appears darker gray. Skin is visible in digital mammography as a white edge. Striated chest wall muscle is commonly visible in the mammographic mediolateral views (Figure 6) **(Jesinger, 2014)**.

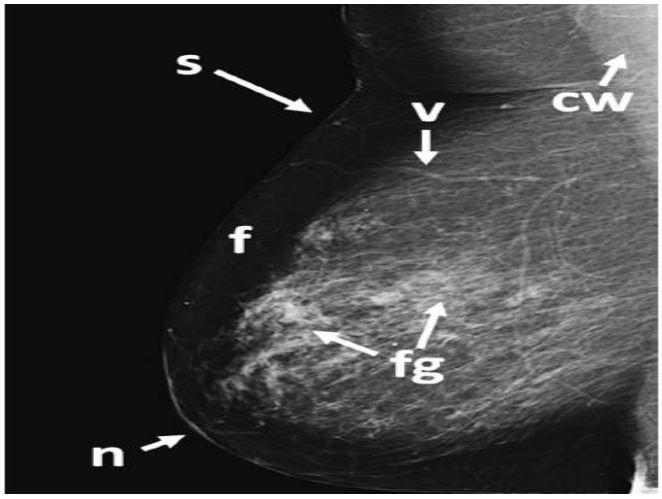

Figure 6: Normal mammographic breast anatomy, chest wall (cw), skin (s) with a centrally positioned nipple (n), fat (f), fibroglandular breast tissue (fg) and neurovascular structures (v) **(Jesinger, 2014)**.

There is a big variation in the appearance of a normal breast in a mammogram, mainly as to the composition of the parenchyma which vary from almost totally fatty to extremely dense **(American College of Radiology, 2015)**.

Fatty breasts have excellent background tissue for tumor visualization, whereas high density can obscure tumor visualization.

The BI-RADS composition of the breast is divided into four categories:

1. Category 1: breast with complete fatty replacement (less than 25% glandular tissue) (Figure 7a).

2. Category 2: breast with fibroglandular 25-50% glandular tissue (Figure 7b).

3. Category 3: heterogeneously dense breast, which can obscure the detection of small lesions (approximately 51-72% glandular tissue) (Figure 7c).

4. Category 4: extremely dense breast, which can reduce the sensitivity of mammography (more than 75% glandular tissue) (Figure 7d) **(Urban & Urban, 2013)**.

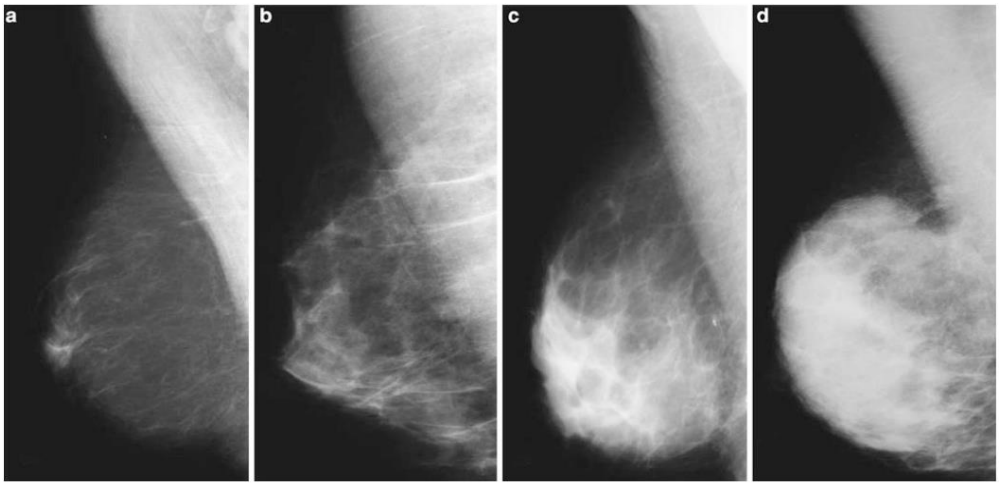

Figure 7: Mammographic patterns of mammary density according to age: (a) severe fatty replacement, (b) sparse fibroglandular densities, (c) heterogeneously dense and (d) extremely dense. Younger women tend to have a greater amount of fibroglandular tissue **(Urban & Urban, 2013)**.

As the age increases the fibroglandular tissue tends to be replaced by fat, the replacement occurs from the posterior region to the anterior region and from medial to lateral, in a symmetric way. An increase in

mammary density can be observed during pregnancy **(Urban & Urban, 2013)**.

Ultrasound anatomy:

On ultrasound, the breast resembles its mammographic appearance. Fat is hypoechoic, whereas fibroglandular tissue is hyperechoic and white. Muscle is usually isoechoic. Ribs usually appear as ovoid structure with posterior shadowing (Figure 8) **(Amy, 2014)**.

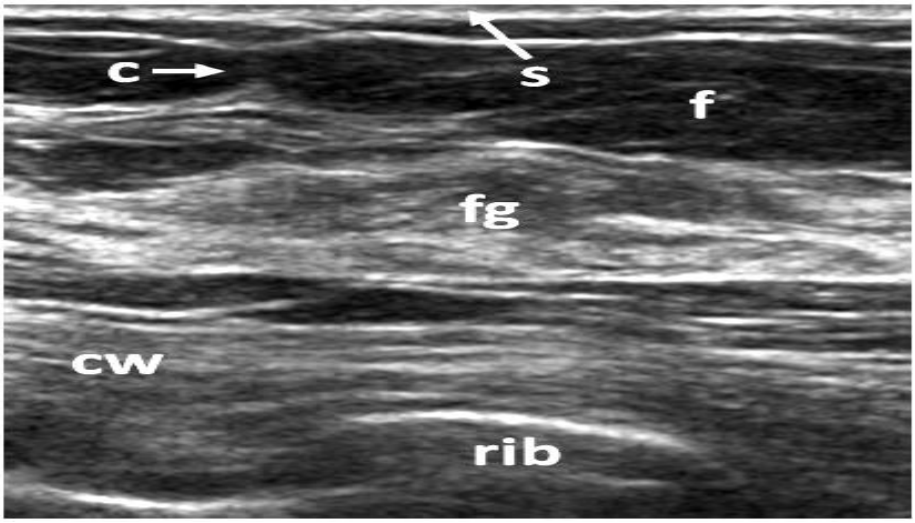

Figure 8: Normal ultrasound breast anatomy. The breast is covered by hyperechoic skin (s) within the breast is fat (f) and fibroglandular tissue (fg). Cooper ligaments (c) and chest wall (cw) with visible ribs **(Jesinger, 2014)**.

Also ultrasonic appearance differs according to proportion of glandular and fatty tissue in different age groups (Figure 9) **(Amy, 2014)**.

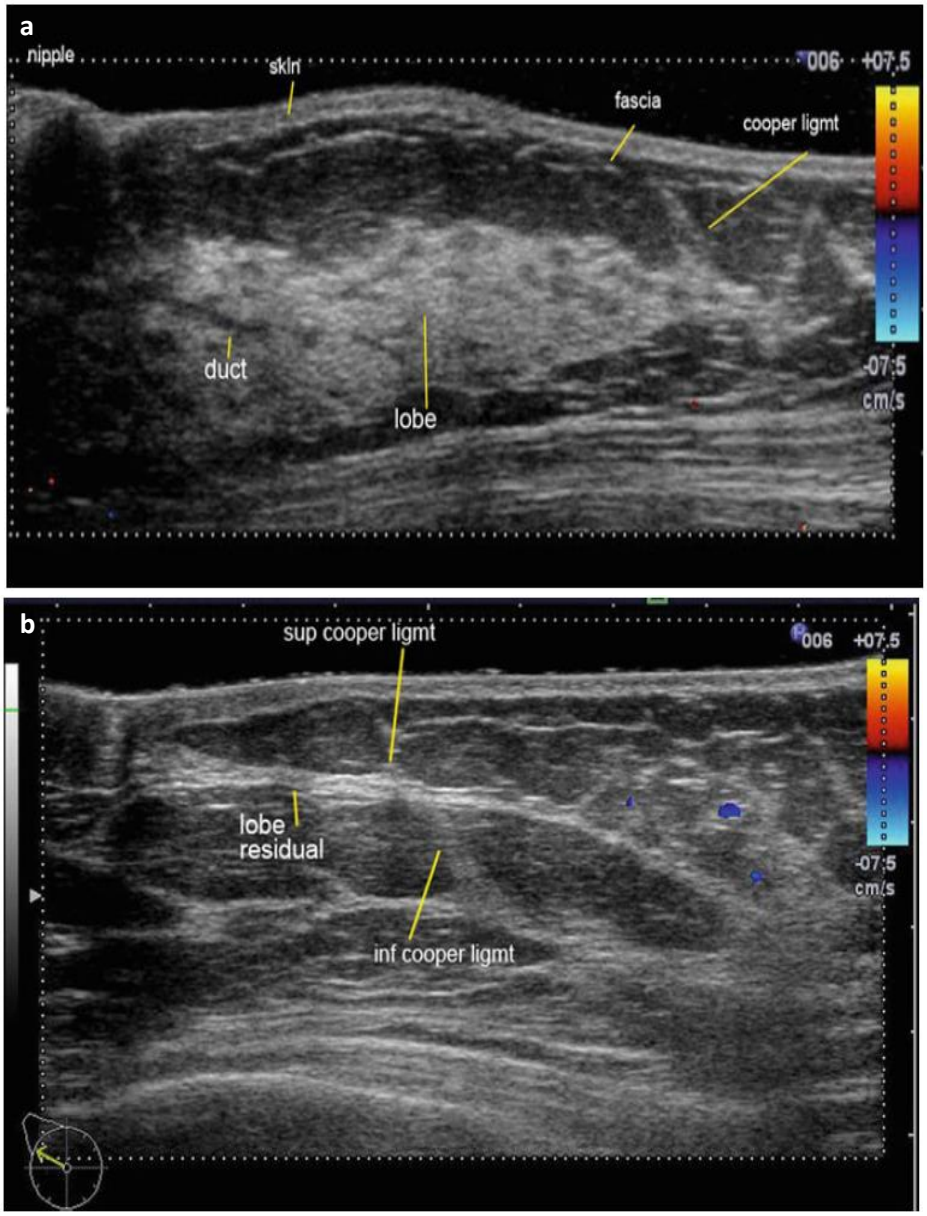

Figure 9: Premenopausal breast (a) and postmenopausal lobar involution (b) **(Amy, 2014)**.