Breast Anatomy and Physiology
Unit 1

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Key to Quality Mammograms

- Knowing the anatomy
- How to position
- Applying adequate compression
Breast Anatomy and Physiology

- Gross Anatomy of the Normal Breast
- Definition
- External Anatomy
- Internal Anatomy
- Histology
Gross Anatomy of the Normal Breast

Definition:

- The breast of an adult woman is a milk-producing, tear-shaped gland.
- It is supported by and attached to the front of the chest wall on either side of the sternum by ligaments.
- Positioned over the pectoral muscles of the chest wall and attached to the chest wall by fibrous strands called Cooper’s ligaments.
Breast Composition

- The breast is a mass of glandular, fatty, and fibrous tissues and contains no muscle tissue.
- A layer of fat surrounds the gland and extends throughout the breast.
- A layer of fatty tissue surrounds the breast glands and extends throughout the breast.
- The fatty tissue gives the breast a soft consistency.
Composition

- milk glands (lobules) that produce milk
- ducts that transport milk from the milk glands (lobules) to the nipple
- nipple
- areola (pink or brown pigmented region surrounding the nipple)
- connective (fibrous) tissue that surrounds the lobules and ducts
- fat
Initial Breast Development

- Human breast tissue begins to develop in the 6th week of fetal life.
- Breast tissue initially develops along the lines of the armpits and extends to the groin (this is called the milk ridge).
- By the 9th week of fetal life, it regresses (goes back) to the chest area, leaving two breast buds on the upper half of the chest.
Initial Breast Development

- In females, columns of cells grow inward from each breast bud, becoming separate sweat glands with ducts leading to the nipple.
- Both male and female infants have very small breasts and actually experience some nipple discharge during the first few days after birth.
Gross Anatomy of the Normal Breast

Developmental stages:

- **At birth**, the breasts of men and women are the same and are not well developed at this stage.
- **In early puberty**, the areola becomes a prominent bud, and breasts begin to fill out.
- **In late puberty**, glandular tissue and fat increase in the breast, and the areola becomes flat.
Gross Anatomy of the Normal Breast

Male vs. Female anatomy

- **Male breasts** are composed of fat, with some glandular tissue.
- They also show areolas and nipples.
- **Female breasts** have similar structures, but, in addition, contain:
  - glandular tissue (lobes, lobules)
  - acini,
  - ducts,
  - Cooper’s ligaments,
  - Montgomery’s glands
Development

- Female breasts do not begin growing until puberty—the period in life when the body undergoes a variety of changes to prepare for reproduction.
- Puberty usually begins for women around age 10 or 11.
- After pubic hair begins to grow, the breasts will begin responding to hormonal changes in the body.
- Specifically, the production of two hormones, estrogen and progesterone, signal the development of the glandular breast tissue.
Development

- This initial growth of the breast may be somewhat painful for some girls.

- During this time, fat and fibrous breast tissue becomes more elastic.

- The breast ducts begin to grow and this growth continues until menstruation begins (typically one to two years after breast development has begun).

- Menstruation prepares the breasts and ovaries for potential pregnancy.
<table>
<thead>
<tr>
<th>Before puberty</th>
<th>Early puberty</th>
<th>Late puberty</th>
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<tbody>
<tr>
<td>the breast is flat except for the nipple that sticks out from the chest</td>
<td>the areola becomes a prominent bud; breasts begin to fill out</td>
<td>glandular tissue and fat increase in the breast, and areola becomes flat</td>
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Breast Size, Appearance, and Changes Over Time

- The size and shape of women’s breasts varies considerably.
- Some women have a large amount of breast tissue, and therefore, have large breasts.
- Other women have a smaller amount of tissue with little breast fat.
Factors that may influence a woman’s breast size include:

- Volume of breast tissue
- Family history
- Age
- Weight loss or gain
- History of pregnancies and lactation
- Thickness and elasticity of the breast skin
- Degree of hormonal influences on the breast (particularly estrogen and progesterone)
- Menopause
Size and Appearance

- A woman’s breasts are rarely balanced (symmetrical).
- Usually, one breast is slightly larger or smaller, higher or lower, or shaped differently than the other.
- The size and characteristics of the nipple also vary greater from one woman to another.
Size and Appearance

- In some women, the nipples are constantly erect. In others, they will only become erect when stimulated by cold or touch.

- Some women also have inverted (turned in) nipples.

- Inverted nipples are not a cause for concern unless the condition is a new change.

- Since there are hair follicles around the nipple, hair on the breast is not uncommon.
Nipple and Areola

- The color of the nipple is determined by the thinness and pigmentation of its skin.
- The nipple and areola (pigmented region surrounding the nipple) contain specialized muscle fibers that respond to stimulation to make the nipple erect.
- The areola also houses the Montgomery’s gland that may appear as tiny, raised bumps on the surface of the areola.
- The Montgomery’s gland helps lubricate the areola. When the nipple is stimulated, the muscle fibers will contract, the areola will pucker, and the nipples become hard.
Breast Shape

- Breast shape and appearance undergo a number of changes as a woman ages.
- In young women, the breast skin stretches and expands as the breasts grow, creating a rounded appearance.
- Young women tend to have denser breasts (more glandular tissue) than older women.
Gross Anatomy of the Normal Breast

External Anatomy consists of
- the nipple,
- areola,
- Montgomery’s glands,
- Morgagni’s tubercles,
- skin,
- axillary tail,
- inframammary fold, and
- the margin of the pectoralis major muscle.
Surface Anatomy of Mammary Gland

- 2nd rib
- Tail of breast (axillary prolongation)
- Nipple
- Areola
- 6th or 7th rib
- Inframammary crease
- Craniocaudal diameter (12 to 15 cm)
Gross Anatomy of the Normal Breast

**Internal anatomy** consists of

- fascial layers,
- retromammary space,
- fibrous tissues,
- glandular tissues/lobes
  - lobules
  - terminal ductal lobular unit (TDLU)
- adipose tissues,
- Cooper’s ligaments,
- Pectoral muscle,
- circulatory system, and
- lymphatic channels.
Frontal View Anatomy

- 15-20 lobes
  - Lobules
  - Alveoli
  - Ducts
  - Ampulla
  - Nipple

- Nipple
- Subcutaneous fat
- Cooper’s (suspensory) ligament
- Interlobular connective tissue
- Lobe
- Lobules
- Alveoli
- Mammary fat
- Ampulla
- Ducts
Tissue Types

1. Glandular
2. Fibrous (connective)
3. Adipose

- Glandular
- Fibrous
- Veins (trabeculae)
- Adipose
- Glandular and/or fibrous (connective) tissue
- Adipose (fatty) tissue
- Larger veins

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Normal Anatomy of Breast

- A - Ducts
- B - Lobules
- E - Fat
- F - Pectoralis Major
- G - Chest Wall/Ribs
- Cooper’s Ligaments

Enlargement:
- A - normal duct cells
- B - basement membrane
- C - lumen
Sagittal Section Anatomy

- Clavicle
- 1st rib
- Retromammary space
- Pectoralis major muscle
- 6th rib
- Inframammary crease
Tissue Composition

Skin

Glandular tissue

Adipose tissue
1) Parenchyma

2) Fibrous Tissue

3) Glandular Tissue

4) Adipose Tissue
Breast Anatomical Orientation

Lateromedial (LM)

Cranial Caudal (CC) and Mediolateral Oblique (MLO)

Mediolateral (ML)
Histology

- **Terminal ductal lobular unit** is comprised of the extralobular terminal duct, intralobular terminal duct and ductal sinus (acinus).

- **Cellular components** are comprised of epithelial cells, myoepithelial cells, and the basement membrane.
The glandular tissues of the breast house the lobules (milk producing glands at the ends of the lobes) and the ducts (milk passages).

Toward the nipple, each duct widens to form a sac (ampulla).

During lactation, the bulbs on the ends of the lobules produce milk.

Once milk is produced, it is transferred through the ducts to the nipple.
Vasculature

- Arteries carry oxygen rich blood from the heart to the chest wall and the breasts and veins take de-oxygenated blood back to the heart.

- The axillary artery extends from the armpit and supplies the outer half of the breast with blood.

- The internal mammary artery extends down from neck and supplies the inner portion of the breast.
Venous Drain

- Perforating branch of internal thoracic vein
- Perforating branch of posterior intercostal vein
- Tributaries of axillary vein
Nerve Supply

- Sympathetic nerves which reach via 2nd to 6th intercostal nerves
- Overlying skin supplied ant & lateral branch of 4th 5th 6th intercostal nerves
Lymphatic Drainage

- Divided into 6 groups:
  - axillary(lateral) vein group
  - external mammary group(anterior or pectoral) along lower border of pectoralis minor and in relation with lateral thoracic vessels
  - scapular group(posterior or subscapular) along subscapular vessels
  - central group
  - apical/subclavicular
  - interpectoral(Rotters node)
Levels of Lymphatic Drainage

- **Level I**
  - Lymph nod located lateral to pectoralis minor (lateral axillary, external mammary, subscapular)
- **Level II**
  - Deep to pectoralis minor (central and interpectoral).
- **Level III**
  - Medial to or above pectoralis minor (subclavicular).
Lymph Nodes

- Axillary group of lymph nodes
  - pectoral group
  - brachial group
  - subscapular group
  - central group
  - apical group
Cycle of Tenderness

- During each menstrual cycle, breast tissue tends to swell from changes in the body’s levels of estrogen and progesterone.
- The milk glands and ducts enlarge, and in turn, the breasts retain water.
- During menstruation, breasts may temporarily feel swollen, painful, tender, or lumpy.
- Physicians recommend that women practice monthly breast self-exams the week following menstruation when the breasts are least tender.
Fibrocystic breast condition is a common benign (non-cancerous) breast condition related to the menstrual cycle.

Some women with fibrocystic breasts experience cysts (accumulated packets of fluid), lumpiness, areas of thickening, tenderness, or breast pain.

Symptoms of fibrocystic change will usually subside after menopause but may be prolonged if a woman uses hormone replacement therapy.
Cycle of Change

- During pregnancy, breasts become tender and the nipples become sore a few weeks after conception. The most rapid period of breast growth is during the first eight weeks of pregnancy.
- The Montgomery’s gland surrounding the areola becomes darker and more prominent, and the areola itself darkens.
- The nipples also become larger and more erect as they prepare for milk production.
- The blood vessels within the breast enlarge as surges of estrogen stimulate the growth of the ducts and surges of progesterone cause the glandular tissue to expand.
Breast Changes After Menopause

- When a woman reaches menopause (typically in her late 40s or early 50s), her body stops producing estrogen and progesterone.
- The loss of these hormones causes a variety of symptoms in many women including hot flashes, night sweats, mood changes, vaginal dryness and difficulty sleeping.
- During this time, the breasts also undergo change. For some women, the breasts become more tender and lumpy, sometimes forming cysts (accumulated packets of fluid).
Breast Changes After Menopause

- The breasts’ glandular tissue, which has been kept firm so that the glands could produce milk, shrinks after menopause and is replaced with fatty tissue.
- The breasts also tend to increase in size and sag because the fibrous (connective) tissue loses its strength.
- Because the breasts become less dense after menopause, it is often easier for radiologists to detect breast cancer on an older woman’s mammograms, since abnormalities are not hidden by breast density.
Clock Positions & Quadrants

- Physicians will often use “clock” and quadrant terminology
Radiographic Appearance

- On mammogram images, breast masses, including both non-cancerous and cancerous lesions, appear as white regions.
- Fat appears as black regions on the images. All other components of the breast (glands, connective tissue, tumors, calcium deposits, etc.) appear as shades of white on a mammogram.
Radiographic Appearance

- In general, the younger the woman, the denser her breasts.
- As a woman ages, her breasts become less dense and the space is filled with fatty tissue shown as dark areas on mammograms.
- It is usually easier for radiologists to detect breast cancer in older women because abnormal areas are easier to spot.
Reference

- Mosby, 2008
- Imaginis