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The Interventionist's Guide to Breast Anatomy

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ABSTRACT:

Various imaging modalities can show the normal breast architecture. An interventionist should be familiar with normal breast anatomy when performing imaging examinations in order to avoid mistaking normal anatomy for a pathologic disease and causing injury to a patient by performing an unneeded procedure. Planning safe breast interventions and avoiding unintended procedural problems requires a thorough understanding of breast anatomy. The major anatomical components of the breast are located above the chest wall and comprise skin, fat, fascial layers, Cooper ligaments, fibroglandular tissue, lymphatics, and neurovascular structures. The breast parenchyma in men often consists only of fat and lacks fibroglandular tissue. Age-related changes in fibroglandular tissue volumes in women result in a predominance of fat in the breasts for many women. During the fourth through twelfth weeks of gestation, skin precursor cells genetically and hormonally influence the development of the breast. The resulting breast bud then continues to lengthen and branch throughout the remaining weeks of gestation, forming a complex network of radially arranged breast ducts that connect the nipple with the mammary lobules. The internal thoracic artery is the major arterial blood vessel that supplies blood to the breast, however the intercostal and lateral thoracic arteries also provide blood to the breast. With some variance in communication channels between deep and superficial venous and lymphatic channels, the venous anatomy and lymphatic drainage of the breast largely parallel the artery anatomy. It is common practice to evaluate the degree of breast disease and inform breast therapies using tools

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that evaluate breast vascular structures (such as contrast-enhanced breast magnetic resonance imaging) and lymphatic structures (such as nuclear medicine lymphoscintigraphy).

KEYWORDS Breast, Anatomy, Breast Interventions.

INTRODUCTION

It's crucial to comprehend breast anatomy and how it appears on imaging investigations for a number of reasons. First of all, no interventionist would want to perform an intervention on a patient and perhaps cause injury by mistaking differences in normal anatomy for a pathologic disease. Second, knowing where a breast anomaly lies within the context of the surrounding normal anatomy frequently helps to focus the list of potential diagnoses for the anomaly. In order to provide patients with the best possible care, any discrepancy between the pathologic diagnosis made from tissue or fluid samples and the clinical or imaging diagnosis must be reviewed and clarified. This is because radiologic-pathologic correlation is frequently used after a breast intervention (for example, the discussion of a breast biopsy at a multidisciplinary breast conference). This article summarizes what is currently known about breast anatomy with an emphasis on the anatomy that is important for diagnosis and treatment.

Breast Embryology

In the fourth week of embryonic life, skin precursor cells (ectoderm) influence genetic and hormonal development of the human breast. [1] Humans develop ectodermal thickenings (also known as mammary ridges) on the chest at the level of the fourth intercostal gap, which develop into a mammary bud by the fifth week of pregnancy. The primary mammary bud develops into the chest during weeks five through twelve of pregnancy, when it gives rise to secondary buds and mammary lobules. Throughout pregnancy, the background breast stroma, which consists of fat, ligaments, nerves, arteries, veins, and lymphatics, grows. After the twelfth week of pregnancy, the secondary buds keep growing and branching, generating a complex network of radially distributed breast ducts that link the developing (inverted) nipple with the expanding mammary lobules. After birth, the nipple typically everts as a result of the growth of lubricating sebaceous glands (of Montgomery) and the development of erectile tissue, while the pigmentation of the surrounding areola rises. Nipple eversion failure can happen, is frequently inherited, and is typically brought on by the nipple's fibrous tethering to a hypoplastic ductal system. The breasts become dormant until puberty begins when the effects of maternal hormones stop after delivery.

Breast expansion changes between male and female breasts when puberty begins. In contrast to estrogen's proliferative influence on the female ducts and stroma, androgenic antagonistic effects on ductal and stromal growth occur in the male breast during the peripubertal age. Puberty causes the circulating

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estrogen in the female breast to increase, which stimulates the formation of fat and periductal connective tissue as well as the lengthening and thickening of the ductal system. Girls who experience early puberty may develop palpable retro-areolar tissue that resembles a "breast mass," which should not be biopsied because doing so could impede breast development.

Breast lobules have a single layer of epithelial lobular cells that develop for lactation beneath a layer of myoepithelial cells. Following delivery, the hormone prolactin stimulates the lobular epithelial cells to create and secrete milk proteins, while the hormone oxytocin causes the myoepithelial cells that surround the lobular alveoli to contract, releasing milk for the nursing infant. The lobular epithelial cells revert to their nonfunctioning state once breastfeeding is stopped.

Breast Anatomy and Imaging Appearances

The human breast is a modified cutaneous exocrine gland made up of skin and subcutaneous tissue, breast parenchyma (ducts and lobules), and supporting stroma, including fat, interspersed in a complex network of ligaments, nerves, arteries and veins, and lymphatics. This information was covered in more detail in the previous section. The midaxillary line runs laterally along the sternum medially along the borders of the breast in both men and women, from the second rib superiorly to the sixth rib inferiorly.

In addition to a superficial fibrous extension of Cooper ligaments, the anterior facial layer also serves as a connection between the skin over the breast and the underlying breast tissue. [2] Both an anterior and a posterior facial layer wrap the deep parenchymal tissues of the breast. [3] The female breast is typically bigger and contains more fibro- glandular tissue than the male breast, which is almost entirely made of fat. Several imaging modalities, such as mammography, ultrasound, breast magnetic resonance imaging (MRI), and breast-specific gamma-ray imaging, can be used to examine the anatomy of the breasts in both men and women.

Normal Parenchymal Breast Anatomy

Skin, fat, fibroglandular breast tissue (ducts, lobules, and supporting fibrous tissue), and neurovascular structures make up the breast's main anatomy. These components are all located above the chest wall. On a clinical examination, the patient's age, together with the size and shape of the breasts, are not always indicators of the quantity of internal fibroglandular tissue. The proportion of active glandular tissue in the breast relative to adipose tissue is typically doubled during pregnancy and lactation. After nursing stops, the glandular tissue shrinks, which occasionally causes a variation in breast size due to the infant's preference for unilateral breast feeding. Between four and eight primary milk ducts leave at the nipple,

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and the anatomically shown ductal network is varied, complex, and not necessarily symmetrically or perfectly radially organized. [4]

Digital mammography is the breast imaging technique that is most frequently employed. On mammography images, fibro- glandular tissue appears white with fat interposed and a darker gray border. The gray-scale anatomy of the breast appears similar to how it does on mammography on ultrasonography. In terms of gray-scale intensity, fibroglandular tissue is hyperechoic and white, while fat is hypoechoic and dark gray. [5,6] The reference tissue for muscles typically appears midgray (isoe- choic). Ovoid ribs feature poste- rior shadowing and hyperechoic white anterior borders, and they are typically evident within the chest wall.

Normal Breast Vascular Anatomy

The amount of the breast parenchyma and physiological activity, such as pregnancy and lactation, both affect the breast's blood supply. With the biggest concentration of blood arteries in the nipple, premenopausal women often have more blood volume in the breast than postmenopausal women.

The internal thoracic (mammary) artery, intercostal arteries, and the lateral thoracic artery are the main sources of the vascular supply to the breast. The internal and lateral thoracic arteries' arterial branches superficially arborize across the breast and shoot perforating branches further into the breast parenchyma. The medial and central breast parenchyma are supplied by the internal thoracic artery and its branches, respectively. The superolateral breast parenchyma is supplied by the lateral thoracic artery. The medial and central breast parenchyma are supplied by the internal thoracic artery and its branches, respectively. The superolateral breast parenchyma is supplied by the lateral thoracic artery.

The paired arterial and venous branches observed with the posterior intercostal, axillary, and internal thoracic (mammary) vascular pathways show that the venous anatomy of the breast is similar to the arterial anatomy in the deep breast tissues. The superficial venous architecture varies and does not correspond to the arterial supply. Intramammary venous anastomoses and the lack of valves in breast veins are usual. On a variety of imaging modalities, blood vessels in the breast are frequently apparent, although discriminating between arteries and veins is frequently challenging. In general, veins are larger than arteries, however this may be due to breast compression during imaging (such as with mammography), chest wall compression with breast MRI coils, or gravity effects (such as with the prone posture during stereotactic biopsy and MRI).

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In most female breasts, breast arteries can be seen, and arterial spectral Doppler analysis typically shows a low-resistance pattern. Age, the menstrual cycle, and vasoactive drugs can all have an impact on breast vascularity. [7,8]

The radiologist can also recognize vascular anomalies crucial to surgeons doing excisions and breast reconstructive surgery by having a working knowledge of the breast vascular anatomy. Nuclear medicine breast-specific gamma imaging, using Technetium-99 m bonded to sestamibi, is available to evaluate breast tissue when breast MRI is inappropriate for a patient. Breast cancer is frequently suspected when the radiopharmaceutical exhibits abnormally hyperintense localisation.

Normal Breast Lymphatic Anatomy

Intramammary and axillary lymph nodes, which are frequently seen on imaging examinations, are lymph nodes that drain the breast in a manner similar to how veins do. The walls of the mammary ducts and the connective tissue between the lobes are the source of the breast's extensive lymphatic system. Particularly in the subareolar plexus at the nipple, deep lymphatic channels communicate with the cutaneous lymphatic plexus, which is more superficial.

Nuclear medicine lymphoscintigraphy is the most used method for determining the lymphatic drainage in the breast outside of mammography, ultrasound, and breast MRI. The sentinel lymph node can be located via lymphoscintigraphy, and if it turns out to be histopathologically cancer-free, the patient can avoid having to have all of their axillary lymph nodes removed.

Summary

An interventionist needs to be familiar with the typical anatomy of the breasts using the many imaging techniques available today. Age-related changes in breast fibroglandular tissue volumes can result in a predominance of fat in the breasts for many women. Breast lymphatic drainage is crucial for helping the breast surgeon and oncologist appropriately stage the severity of the disease, and assessing breast vascularity has emerged as a critical objective in the early diagnosis of breast cancer.

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