The Nuts and Bolts of Breastfeeding: Anatomy and Physiology of Lactation

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Breastmilk is the physiologic norm for infant nutrition. Despite recommendations from major health organizations, many women in the U.S. are not achieving this metric. Understanding breast anatomy and lactation physiology will allow physicians to gain knowledge of the processes, which control lactation enabling physicians to appropriately manage the breastfeeding dyad. The interplay of hormones involved in lactation and milk management affect milk initiation, as well as ongoing milk production (galactopoesis). The unique components of breastmilk that provide protection against infection and chronic diseases also change between and during feeds. Colostrum and the importance of early skin-to-skin after delivery will also be discussed.

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Many seasoned practicing physicians, who take care of infants, were trained when only 20–25% of new mothers were initiating breastfeeding. Some pediatricians still recommend that mothers discontinue breastfeeding for conditions that are compatible with breastfeeding.[9] Breastfeeding education is neither mandatory nor provided within many pediatric or family medicine residencies. Over 71% of both practicing pediatricians and OB-Gyns felt they had little or no breastfeeding education or training. Due to lack of knowledge and training, many physicians lack confidence in counseling their patients on infant feeding choices. Even though 90% of physicians endorsed that they have a role in breastfeeding promotion, only half felt that they could effectively counsel patients about breastfeeding.[10]

The lack of knowledge and comfort is not surprising considering that in medical school, students do not learn about lactation anatomy and physiology. Some trainees and physicians may 'learn on the job' whether during their own experience and/or during internship and residency. However, unless a physician seeks out additional learning and training, many physicians lack the knowledge to properly counsel breastfeeding mothers in those early days, which, as this article will describe, is essential to establishing milk supply and thus allowing mothers to not only initiate breastfeeding, but to exclusively breastfeed for as long as they and their babies desire.

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Embryology

In the 20-day-old embryo, the precursors of the breasts begin initially as milk streaks or lines that eventually develop in the mammary ridges. At week 6, the nipple and areola begin to form, along with proliferation of the milk ducts. This process continues until birth. At week 28, placental sex hormones induce canalization. At birth, maternal hormones can induce inflammation that can cause that newborn to secrete 'witch's milk.' This is considered a normal physiological occurrence and no treatment or testing is necessary. Until puberty, the mammary glands remain inactive in females.

Breast bud development, known as *thelarche* is the 1st sign of puberty (range 8–13.5 y/o). Hormones such as estrogen, progesterone, corticosteroids, and thyroxine influence the growth and proliferation of the ducts and alveolar buds, which continue to grow with each successive menstrual cycle. Connective tissue (Cooper's ligaments) and protective fatty tissue are also a part of the breast architecture.[11]

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Breast Anatomy

So how does the breast change during pregnancy and lactation? During the 1st trimester, there is rapid growth of the ductural-lobular-alveolar system in the breasts. As the alveoli proliferate, distinct lobules are formed. For each woman and each pregnancy, there is variation in the timing and degree of glandular growth. While there is extensive growth during the 1st trimester, there is gradual growth throughout the pregnancy. Glandular luminal cells begin actively synthesizing milk fat and proteins near term, however only small amounts are released into lumen. However, there is no growth until just before and after the birth of the baby. With postpartum withdrawal of luteal and placental sex steroids and placental lactogen, prolactin is able to induce full secretory activity of alveolar cells and the release of milk into alveoli and smaller ducts.[12]

Regarding blood supply the internal mammary artery supplies the majority (60–70%) of the blood supply to the breast, while the remainder is supplied by the lateral thoracic artery (30–40%). Lymphatic drainage of the breast drains to the axillary lymph nodes. This is important to remember as poor drainage of the breast can result in increased and size and pain of the axillary lymph nodes. Intercostal nerves IV, V and VI supply nerve inervation to the breast. Due to the nerve distribution, the areola is most sensitive. Physicians must keep this in mind when counseling women with a history of breast surgery, as the 4th intercostal nerve lies more superficially close to areola at the outer lower quadrant, which is primarily responsible for nipple sensation.

Since it is usually unknown how the surgery was done, these women may be unable to exclusively breastfeed due to a decreased milk supply.

The size of the breasts do not determine the amount of milk that will be synthesized. Pre-conception breast size has no relation to the degree of increase in breast size during pregnancy. The storage capacity of the breast is not determined by breast size, but the adipose tissue determines visible breast size. Also there is no relation between the growth of the breast during pregnancy and the amount of milk the breasts produce during the 1st month of lactation.

While the alveolar cells store the milk that is produced, the maximum volume of milk stored in the breast covers a wide range (80–600 ml). Breast capacity is not a limiting factor to total daily milk production. However, smaller capacity breasts will be emptied more quickly with faster breastmilk synthesis as compared to larger capacity breasts.[13,14]

Lactation Physiology

There are various stages of lactogenesis (milk production).

<u>Lactogenesis I</u> occurs at 15–20 weeks gestation. This stage is hormonally driven. All women, at this stage of pregnancy, will be able to synthesize milk components. Colostrum production begins midway through the pregnancy.

<u>Lactogenesis II</u> occurs 30–40 hours after birth. It is initiated by the birth of infant plus removal of the placenta. Any functional placental tissue (progesterone) will inhibit or compromise the effective initiation of lactogenesis II. The key hormone during this stage is