AUGOYE OMESIRI

ANATOMY

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Discuss lactation and gestation period in a normal female

LACTATION

The normal physiology of lactation is a process that begins to take effect well before the initial latch of the newborn infant. It requires the breast to change in composition, size, and shape during each stage of female development. Development includes puberty, pregnancy, and lactation. These stages are influenced by a cascade of physiologic changes that are crucial to successful breastfeeding. This article will review the development of the mammary gland (mammogenesis), the process by which the mammary gland develops the ability to secrete milk (lactogenesis), and the process of milk production (lactation).

The process of lactation and breastfeeding can be negatively affected by anything that interrupts the normal development of the female breast, or that interferes with the production of milk. Women who have had breast augmentation may experience issues with lactation and breastfeeding, but this is dependent on the location of the incision. Incisions made in the armpit are more favorably for normal breastfeeding; whereas, the "smile" incision around the areola increases the woman's risk of having breastfeeding issues.

In the post-partum period, some women may experience difficulty with lactation if they have inadequate milk production, poor milk extraction, and insufficient caloric intake to meet demands. Current recommendations for lactating women are to have a minimum excess of 500 calories per day to meet the caloric demands for milk production. Women are also encouraged to empty the breast as often as possible, typically every 2 to 3 hours to maintain milk supply.

Other issues of concern regarding lactation include the infant’s inability to latch, nipple pain, mastitis, or plugged ducts.

Development

During puberty, lobule type 1 is formed. Changes in the level of estrogen and progesterone during each menstrual cycle stimulate lobule 1 to produce new alveolar buds and eventually evolve to more mature structures, known as type-2 and type-3 lobules. Once puberty is complete, no further changes occur to the female breast until pregnancy.

During pregnancy, stage-II mammogenesis (alveolar development and maturation of the epithelium) occurs largely in response to higher levels of progesterone. The increased volume of breast tissue during pregnancy is a result of the proliferation of secretory tissue. In early pregnancy, lobule type 3 is formed due to the influence of chorionic gonadotropin. These newly formed lobules have larger size and number of epithelial cells composing each acinus. In late pregnancy, the proliferation of new acini are reduced, and the lumen becomes distended with secretory material or colostrum.

During labor and lactation, further growth and differentiation can be seen in the lobule along with milk secretion. The glandular component of the breast has now increased to the point where it is mainly formed of epithelial elements and very little stroma. This will persist throughout lactation.

Finally, the involution of mammary glands occurs with the cessation of lactation and requires a combination of lactogenic hormone deprivation and local autocrine signals that signal apoptotic cell death and tissue remodeling. Full regression does not occur, and pregnancy causes a permanent increase in the size and number of lobules. Following lactation, there is always the potential of the glands to produce milk in response to regular stimulation.

## Pathophysiology

Lactogenesis is the process of developing the ability to secrete milk and involves the maturation of alveolar cells. It takes place in 2 stages: secretory initiation and secretory activation.

* Stage I lactogenesis (secretory initiation) takes place during the second half of pregnancy. The placenta supplies high levels of progesterone which inhibit further differentiation. In this stage, small amounts of milk can be secreted by week 16 gestation. By late pregnancy, some women can express colostrum.
* Stage II lactogenesis (secretory activation) starts with copious milk production after delivery. With the removal of the placenta at delivery, the rapid drop in progesterone, as well as the presence of elevated levels of prolactin, cortisol, and insulin, are what stimulate this stage. Usually, at days 2 or 3 postpartum, most women experience swelling of the breast along with copious milk production. In primiparous women, the secretory activation stage is slightly delayed, and early milk volume is lower. Lower milk volume is also observed in women who had cesarean births compared with those who delivered vaginally. Late onset of milk production has also been seen in women who have had retained placental fragments, diabetes, and stressful vaginal deliveries. With retained placental fragments, lactogenesis stage II could be inhibited by the continued secretion of progesterone and would continue to be inhibited until removal of the remaining placental fragments.

Lactation is maintained by regular removal of milk and stimulation of the nipple, which triggers prolactin release from the anterior pituitary gland and oxytocin from the posterior pituitary gland. For the ongoing synthesis and secretion of milk, the mammary gland must receive hormonal signals; and although prolactin and oxytocin act independently on different cellular receptors, their combined action is essential for successful lactation.

Prolactin is a polypeptide hormone synthesized by lactotrophic cells in the anterior pituitary and is structurally similar to growth hormone and placental lactogen. Prolactin is both positively and negatively regulated, but its main control comes from hypothalamic inhibitory factors such as dopamine which act on the D2 subclass of dopamine receptors present in lactotrophs. Prolactin stimulates mammary gland ductal growth and epithelial cell proliferation and induces milk protein synthesis. Emptying of the breast by the infant's suckling is thought to be the most important factor. Prolactin concentration increases rapidly with suckling of the nipple which stimulates nerve endings located there.

Oxytocin is involved in the milk ejection or letdown reflex. The tactile stimulation of the nipple-areolar complex by suckling leads to afferent signals to the hypothalamus that trigger release of oxytocin. This results in contraction of the myoepithelial cells, forcing milk into the ducts from the alveolar lumens and out through the nipple. Oxytocin also has a psychological effect, which includes inducing a state of calm, and reducing stress. It may also enhance feelings of affection between mother and child, an important factor in bonding.

Once lactation is established and maintained, production is regulated by the interaction of both physical and biochemical factors. If milk is not removed, elevated intramammary pressure and accumulation of a feedback inhibitor of lactation reduce milk production and initiate mammary involution. If breast milk is removed, the inhibitor is also removed, and secretion will resume. The role of the feedback inhibitor of lactation is to regulate the amount of milk produced which is determined by how much the baby takes, and therefore by how much the baby needs.

Gestation period

The gestation period is how long a woman is pregnant. Most babies are born between 38 and 42 weeks of gestation.

Babies born before 37 weeks are considered premature. Babies born after 42 weeks are called postmature.

Gestational age

The actual date of conception generally isn’t known for humans, so gestational age is the common way to measure how far along a pregnancy is. Where your baby is in their development — such as whether their fingers and toes have formed — is tied to gestational age.

Gestational age is measured in weeks from the first day of your last menstrual period. This means that your last period counts as part of your pregnancy. Even though you weren’t actually pregnant, your period is a signal that your body is preparing for pregnancy.

Fetal growth doesn’t actually start until conception, which is when sperm fertilizes an egg.

Your doctor can also determine gestational age using an [ultrasound](https://www.healthline.com/health/pregnancy/ultrasound) or after delivery.

During an ultrasound, your doctor will measure your baby’s head and your abdomen to determine gestational age.

After birth, gestational age is determined using the Ballard Scale, which assesses the physical maturity of your baby.

Gestational age is divided into [two periods](https://www.healthline.com/health/prenatal-development): embryonic and fetal. The embryonic period is week 5 of pregnancy — which is when the embryo implants in your uterus — to week 10. The fetal period is week 10 to birth.