

REPRODUCTIVE PHYSIOLOGY

PARTURITION AND LACTATION GUYTON AND HALL CH83

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OBJECTIVES

By the end of this lecture:

- You may appreciate more your Mom!
- You will be able to recognize hormonal Factors that induce parturition
- Describe the role of Oxytocin in contraction of the uterus during parturition
- Describe labor mechanics
- Recognize physiology of lactation

PARTURITION

- Parturition means birth of the baby.
- Toward the end of pregnancy, the uterus becomes progressively more excitable, until finally it develops such strong rhythmical contractions that the baby is expelled. The exact cause of the increased activity of the uterus is not known, but at least two major categories of effects lead up to the intense contractions responsible for parturition:
 - (1) progressive hormonal changes that cause increased excitability of the uterine musculature
 - (2) progressive mechanical changes.

PARTURITION

Hormonal Factors That Increase Uterine Contractility

- Increased Ratio of Estrogens to Progesterone.
- Progesterone inhibits uterine contractility, however, estrogens increase the degree of uterine contractility, partly because estrogens increase the number of gap junctions between the adjacent uterine smooth muscle cells
- from the seventh month onward, estrogen secretion continues to increase while progesterone secretion remains constant or perhaps less

PARTURITION

Oxytocin Causes Contraction of the Uterus

Oxytocin, a polypeptide secreted by the neurohypophysis, specifically causes uterine contraction.

- There are four reasons to believe that oxytocin might be important in increasing the contractility of the uterus near term:
 1. The uterine muscle increases its oxytocin receptors last few months of pregnancy.
 2. The rate of oxytocin secretion by the neurohypophysis is increased at the time of labor.
 3. Although hypophysectomized animals can still deliver their young at term, labor is prolonged.
 4. Experiments in animals indicate that irritation of cervix cause a neurogenic reflex through the paraventricular and supraoptic nuclei of the hypothalamus that causes secretion of oxytocin.

PARTURITION

Effect of Fetal Hormones on the Uterus.

The fetus's pituitary gland secretes increasing quantities of oxytocin,

- fetus's adrenal glands secrete large quantities of cortisol, another possible uterine stimulant.
- fetal membranes release prostaglandins in high concentration at the time of labor.
- These prostaglandins, can increase the intensity of uterine contraction

MECHANICAL FACTORS THAT INCREASE UTERINE CONTRACTILITY

- **Stretch of the Uterine Musculature.**

Simply stretching smooth muscle organs usually increases their contractility. Further, intermittent stretch, which occurs repeatedly in the uterus because of fetal movements, can also elicit smooth muscle contraction.

- Twins; on average, 19 days earlier than a single child, (importance of mechanical stretch in eliciting uterine contractions).

- **Stretch or Irritation of the Cervix**

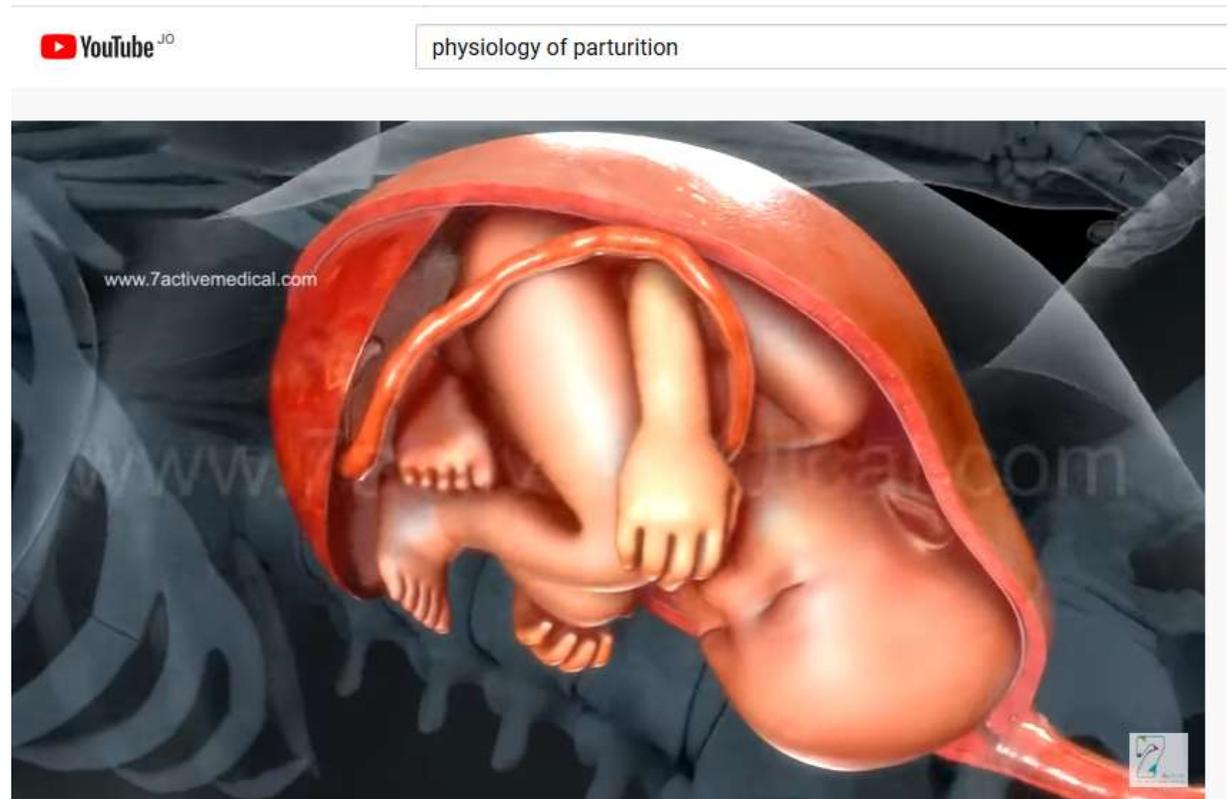
- stretching or irritating the uterine cervix is important in eliciting uterine contractions.

Ex; obstetricians frequently induce labor by rupturing the membranes so the head of the baby stretches or irritates it

- The mechanism: is not known.
- neural reflexes to the body of the uterus or could be only myogenic transmission of stretch

LABOR

Follow link to watch this video illustration of labor
<https://www.youtube.com/watch?v=jFdXx35VR-o>

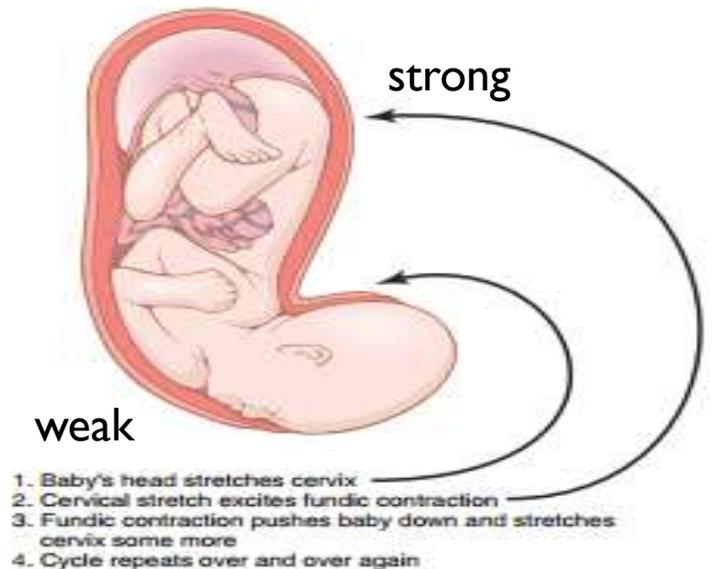
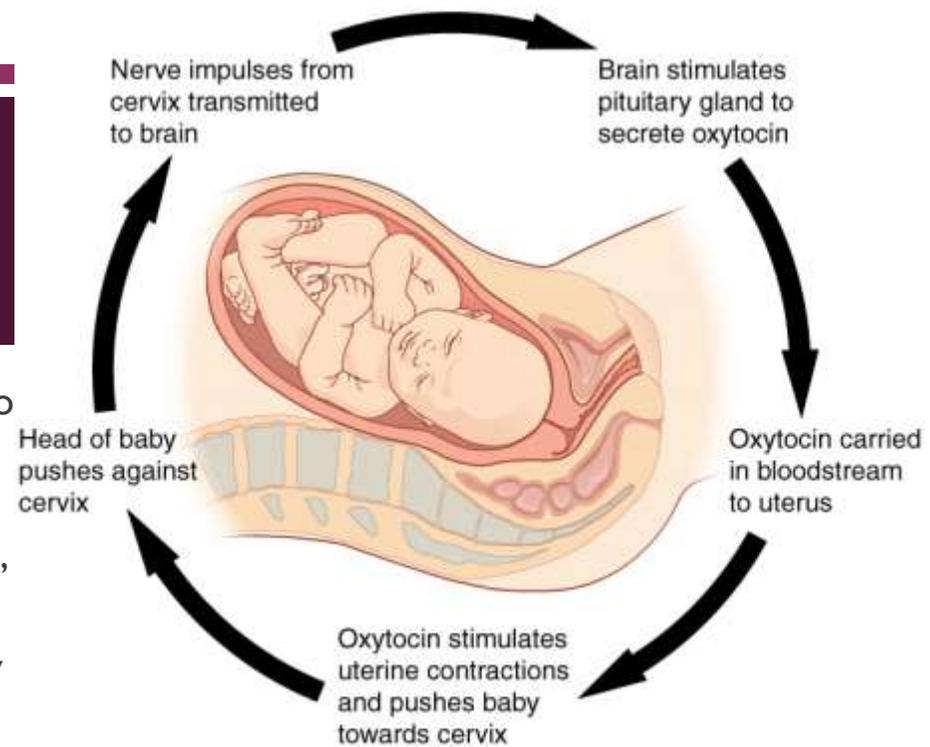


LABOR, A POSITIVE FEEDBACK MECHANISM FOR ITS INITIATION

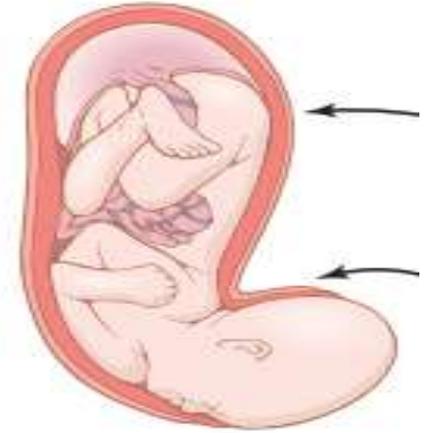
- During most of the months of pregnancy, the uterus undergoes periodic episodes of weak and slow rhythmical contractions called Braxton Hicks contractions.
- They become progressively stronger towards the end of pregnancy; then start stretching the cervix and later force the baby through the birth canal, causing parturition (called labor), and the strong contractions are labor contractions.

The positive feedback theory suggests that stretching of the cervix by the fetus's head finally becomes great enough to elicit a strong reflex

- increase in contractility of the uterine body pushes the baby forward, which stretches the cervix more and initiates more positive feedback to the uterine body. process repeats until the baby is expelled.
- labor contractions obey all the principles of positive feedback
- two known types of positive feedback increase uterine contractions during labor:
 - (1) Stretching of the cervix causes the entire body of the uterus to contract, and this contraction stretches the cervix even more because of the downward thrust of the baby's head
 - (2) cervical stretching also causes the pituitary gland to secrete oxytocin, which is another means for increasing uterine contractility.

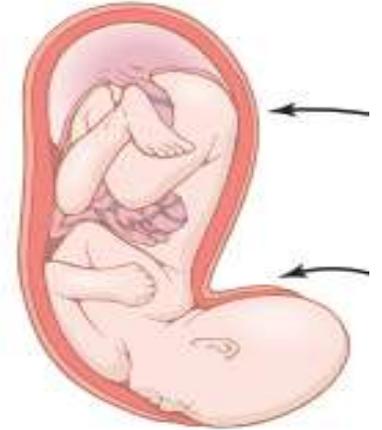


LABOR, ABDOMINAL MUSCLES ROLE



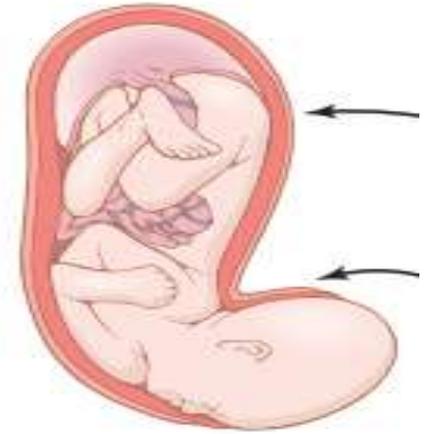
- pain signals originate both from the uterus and from the birth canal.
- These signals, in addition to causing suffering, elicit neurogenic reflexes in the spinal cord to the abdominal muscles, causing intense contractions of these muscles.
- The abdominal contractions add up to uterine contractions toward expulsion of the baby

LABOR MECHANICS



- early at labor, contractions once every 30 minutes. Rule of 4-1-2
- As labor progresses, the contractions finally appear as often as once every 1 to 3 minutes and the intensity of contraction increases greatly, with only a short period of relaxation between contractions.
- combined contractions of the uterine and abdominal musculature during delivery of the baby cause a downward force on the fetus of about 25 pounds during each strong contraction.
- intermittently? strong stop blood flow through the placenta and would cause death of the fetus if the contractions were continuous.
- Caution when uterine stimulant are used, such as oxytocin, can cause uterine spasm can lead to death of the fetus.
- In more than 95 percent of births, the head is the first part of the baby to be expelled, and in remaining instances, mostly the buttocks are presented first; called a breech presentation.
- Toward the end of pregnancy, the cervix becomes soft, which allows it to stretch when labor contractions begin in the uterus.

LABOR MECHANICS



- The **first stage** of labor is a period of progressive cervical dilation, until the cervical opening is as large as the head of the fetus (complete effacement). lasts for 8 to 24 hours in the first pregnancy, but a few minutes after many pregnancies.
- The fetal membranes usually **rupture** and the amniotic fluid is lost suddenly through the vagina.
- The **second stage** of labor. The head of the fetus moves rapidly into the birth canal, and with additional force from above, it continues to wedge its way through the canal until delivery occurs. it may last from 1 minute after many pregnancies to 30 m.
- follow link to watch this video

<https://www.youtube.com/watch?v=iaVulaVpx5Q>

LABOR, SEPARATION AND DELIVERY OF THE PLACENTA

- For 10 to 45 minutes after birth of the baby, the uterus continues to contract to a smaller and smaller size, which causes a shearing effect between the walls of the uterus and the placenta, thus separating the placenta from its implantation site. Separation of the placenta opens the placental sinuses and causes bleeding 350 ml
- mechanism: The smooth muscle fibers of the uterine musculature are arranged in figures of eight around the blood vessels through the uterine wall.
- it is believed that vasoconstrictor prostaglandins formed at the placental separation site cause additional blood vessel spasm

LABOR PAIN

- In early labor, pain is due to hypoxia of the uterine muscle resulting from compression of the blood vessels in the
- uterus. Via visceral sensory hypogastric nerves, visceral sensory fibers from the uterus.
- During the second stage of labor, much more severe pain is by cervical stretching, perineal stretching, and stretching or tearing of structures in the vaginal canal itself.
- This pain is conducted to the mother's spinal cord and brain by somatic nerves instead of by the visceral sensory nerves
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AFTER LABOR

- During early involution of the uterus, the placental site on the endometrial surface autolyzes, causing a vaginal discharge known as lochia,
- Lochia is first bloody, then serous in nature and continues for a total of about 10 days.
- After this time, the endometrial surface becomes re-epithelialized.

LACTATION

- Estrogens Stimulate Growth of the Ductal System of the Breasts.
- growth hormone, prolactin, the adrenal glucocorticoids, and insulin-----
→protein metabolism
- Progesterone is required for full development of the Lobule-Alveolar System. final development of the breasts into milk-secreting organs progesterone—acting synergistically with estrogen, as well as with the other hormones just mentioned—causes additional growth of the breast lobules, with budding of alveoli and development of secretory characteristics in the cells of the alveoli.

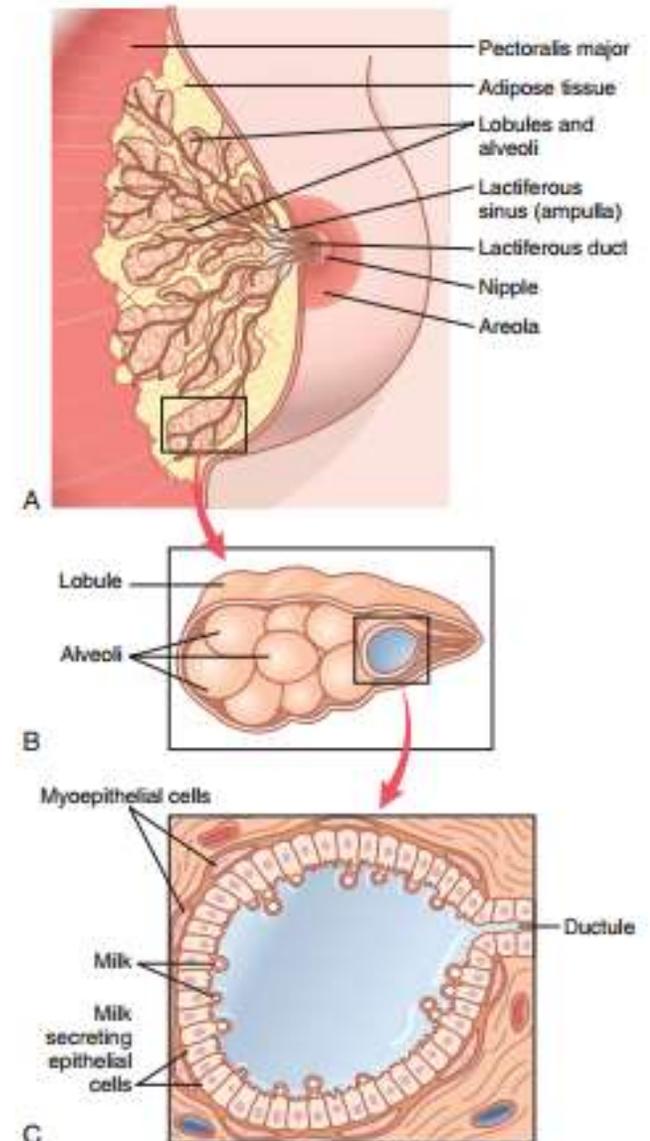
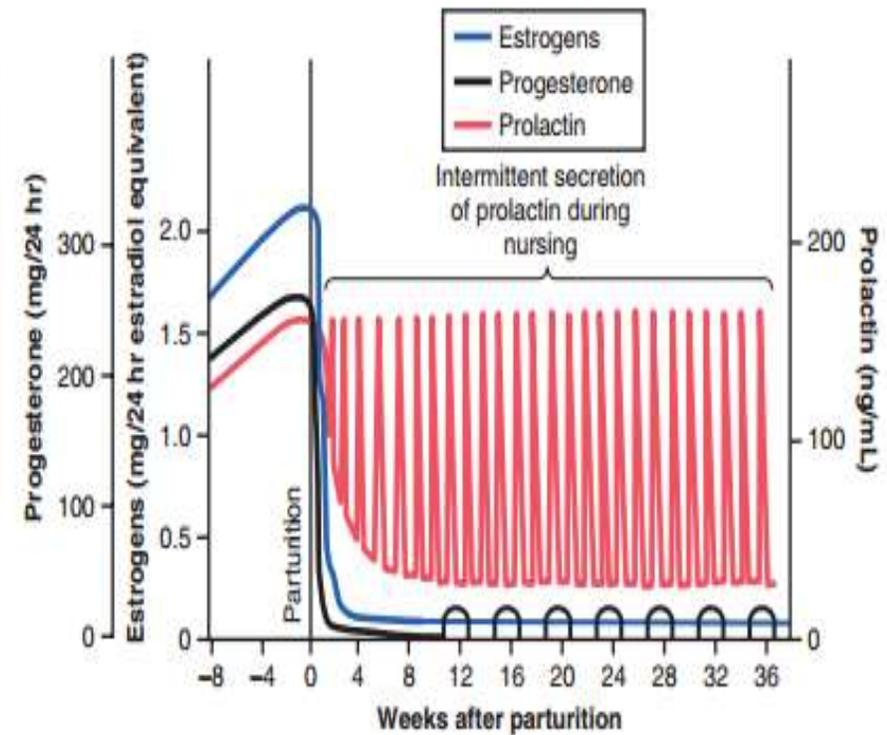


Figure 83-10. The breast and its secretory lobules, alveoli, and

LACTATION

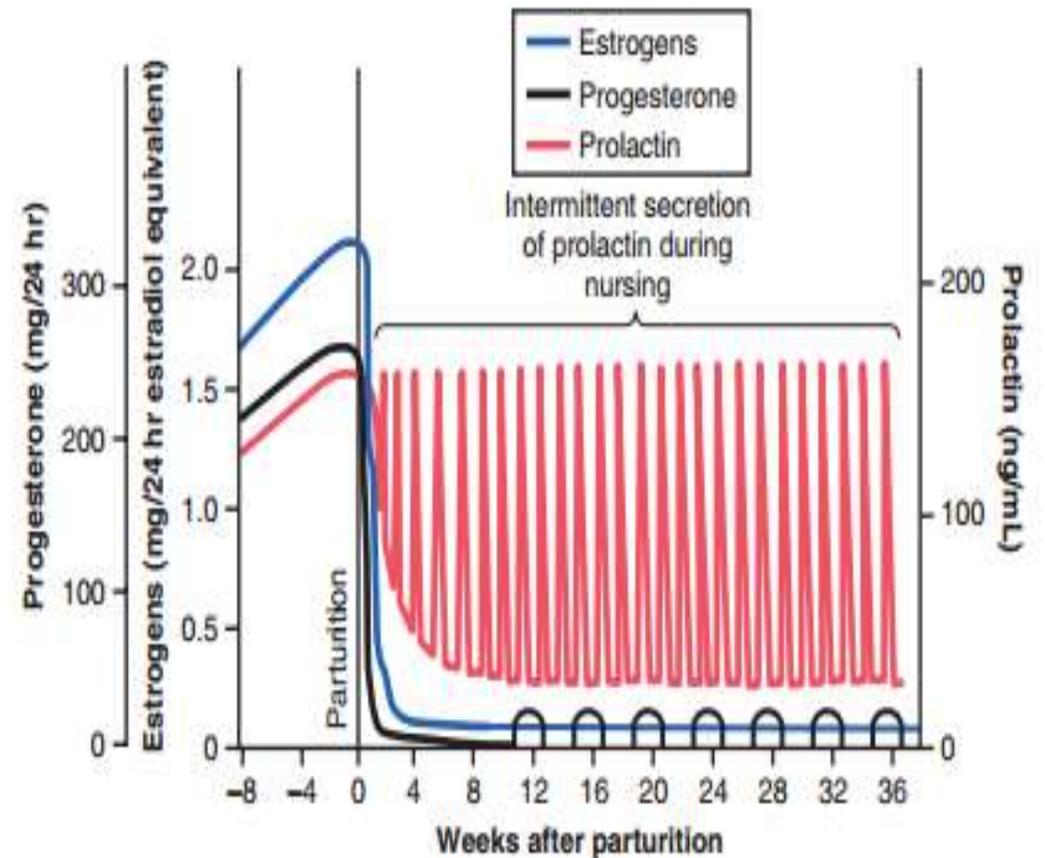
PROLACTIN PROMOTES LACTATION

- Prolactin is secreted by the mother's anterior pituitary gland,
- and its concentration in her blood rises steadily from the fifth week of pregnancy until birth of the baby, at which time it has risen to 10 to 20 times the normal nonpregnant level.
- In addition, the placenta secretes large quantities of human chorionic somatomammotropin, which probably has lactogenic properties, supporting the prolactin
- Suppressive effects of estrogen and progesterone, so that no more than a few milliliters of fluid are secreted until after the baby is born
- Secretions in the last few days before and the first few days after parturition are called colostrum; same concentrations of proteins and lactose as milk, but no fat, and its maximum rate is 1/100 the subsequent rate of milk production.
- Sudden loss of both estrogen and progesterone secretion from the placenta at birth allows the lactogenic effect of prolactin to assume its natural milk-promoting role, and during the next 1 to 7 days, milk is produced instead of colostrum



LACTATION

- Requires an adequate background secretion of growth hormone, cortisol, parathyroid hormone, and insulin. (amino acids, fatty acids, glucose, and calcium)
- After the birth of the baby, the basal level of prolactin secretion returns to the nonpregnant level during the next few weeks
- nervous signals from the nipples to the hypothalamus cause a 10- to 20-fold surge in prolactin secretion that lasts ~ 1 hour
- It keeps the mammary glands secreting milk into the alveoli for the subsequent nursing periods.



PROLACTIN INHIBITORY HORMONE-HYPOTHALAMUS

- The Hypothalamus Secretes Prolactin Inhibitor Hormone.
- The hypothalamus controlling prolactin secretion by inhibiting prolactin production.
- damage to the hypothalamus or blockage of the hypothalamic-hypophysial portal system often increases prolactin secretion while it depresses secretion of the other anterior pituitary hormones.
- Prolactin is inhibited by a factor transported through the hypothalamichypophysial portal system to the anterior pituitary gland.
- The same as the catecholamine dopamine, which is known to be secreted by the arcuate nuclei of the hypothalamus and can decrease prolactin secretion as much as 10-fold.

SUPPRESSION OF THE FEMALE OVARIAN CYCLES IN NURSING

- In most nursing mothers, the ovarian cycle (and ovulation) does not resume until a few weeks after cessation of nursing.
- the same nervous signals from the breasts to the hypothalamus that cause prolactin secretion during suckling—either because of the nervous signals or because of a subsequent effect of increased prolactin—inhibit secretion of gonadotropin-releasing hormone by the hypothalamus.
- This inhibition, in turn, suppresses formation of the pituitary gonadotropic hormones—luteinizing hormone and follicle-stimulating hormone.
- However, after several months of lactation, in some mothers (especially those who nurse their babies only some of the time), the pituitary begins to secrete sufficient gonadotropic hormones to reinstate the monthly female sexual cycle

EJECTION (OR “LET-DOWN”) PROCESS IN MILK SECRETION—FUNCTION OF OXYTOCIN

- Milk does not flow easily from the alveoli into the ductal system,
- Milk must be ejected from the alveoli into the ducts before the baby can obtain it.
- This ejection is caused by a combined neurogenic and hormonal reflex that involves the posterior pituitary hormone oxytocin.
- When the baby suckles, it receives virtually no milk for the first half minute or so. Sensory impulses must first be transmitted through somatic nerves from the nipples to the mother’s spinal cord and then to her hypothalamus where they cause nerve signals that promote oxytocin secretion at the same time that they cause prolactin secretion.
- The oxytocin is carried in the blood to the breasts where it causes myoepithelial cells (which surround the outer walls of the alveoli) to contract, thereby expressing
- the milk from the alveoli into the ducts at a pressure of +10 to 20 mm Hg.
- Then the baby’s suckling becomes effective in removing the milk. Thus, within 30 seconds to 1 minute after a baby begins to suckle, milk begins to flow. This process is called milk ejection or milk letdown.

MILK COMPOSITION

- 1.5 liters of milk may be formed each day (and even more if the mother has twins).
- High energy is drained from the mother; approximately 650 to 750 kcal/L are contained in breast milk,
- Large metabolic substrates are also lost from the mother.
- Diet of mom (milk and vitamin D)
- To supply needed calcium and phosphate, the parathyroid glands enlarge and the bones become decalcified.
- Decalcification is usually not a big problem during pregnancy, but it can become more important during lactation
- multiple types of antibodies and other anti-infectious agents are secreted
- in milk along with the nutrients.
- WBCs are secreted (neutrophils and macrophage) can be lethal to bacteria that could cause deadly infections such as (E-coli)

Constituent	Human Milk (%)
Water	88.5
Fat 50 gm/day	3.3
Lactose 100 gm/day	6.8
Casein	0.9
Lactalbumin and other proteins	0.4
Ash 2 - 3 gm of calcium phosphate	0.2



The end