

YU - Medicine

Passion Academic Team

The Urogenital System

Sheet# 11 - Physiology

Lec. Title : Parturition &
Lactation

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Parturition and lactation

المحاضرة من غايتون صفحة 1064 تشابتر 82 وهاد رابط الكتاب

<https://drive.google.com/file/d/1z24H-RuIe1UNoippFdp8xVNzm0A6vdeP/view?usp=drivesdk>

دعواتكم ، كل الحُبّ....

Parturition

- Parturition is the delivery of the fetus.
- Occurs approximately **40 weeks** after the onset of the last menstrual period.
- the **uterus** becomes progressively **more excitable**, until finally it develops such **strong rhythmical contractions** that the **baby is expelled**.
- The mechanism of parturition is unclear.
- Roles for :
 - **Estrogen**: **lowers** the threshold for muscle excitability = **stimulates** muscle contraction.
 - Progesterone: **counteracts** the function of estrogen and tries to relax the uterus by **raising** the muscle excitability threshold.
 - **Oxytocin**: helps with **contraction**.
 - **Prostaglandins**: enhance the contraction in the uterus by **increasing** the build up and increasing the intracellular calcium.
 - **Relaxin**: **counteracts** the effects of contraction stimulating hormones.
 - **Catecholamines**: mechanism unclear.

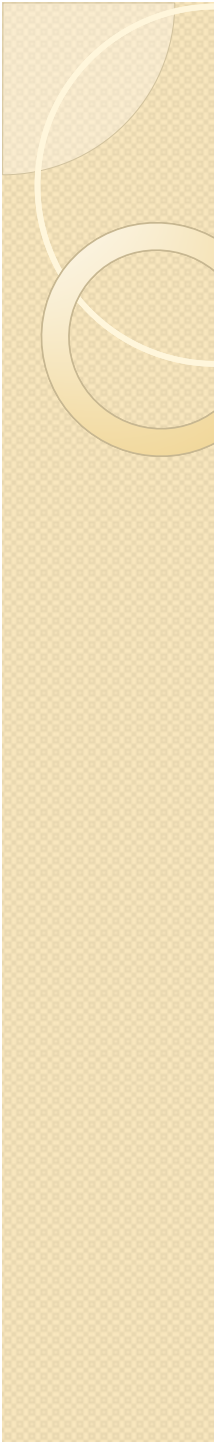
Events that may contribute to parturition

First: mechanical factors:

1. Once the fetus reaches a critical size, **distention (stretching) of the uterus increases its contractility.**
 - Uncoordinated, weak and slow contractions, known as **Braxton Hicks contractions**, begin approximately 1 month before parturition.
2. **Stretch or irritation of the cervix:** elicits uterine contraction by initiating reflexes to the body of the uterus.
3. **Abdominal Muscle Contractions During Labor:**
 - Once uterine contractions become strong during labor, pain signals originate both from the **uterus** and from the **birth canal** → ***elicit neurogenic reflexes*** in the spinal cord to the abdominal muscles → **intense contractions of these muscles.**
 - The abdominal contractions *add greatly to the force that causes expulsion of the baby.*

Second: hormonal factors:

1. Near term, the ***fetal*** hypothalamic-pituitary-adrenal axis is **activated** and the **fetal adrenal cortex produces** significant amounts of **cortisol**. Cortisol increases the **estrogen/progesterone ratio**, which **increases** the sensitivity of the uterus to contractile stimuli.
 - Estrogen and progesterone have **opposite** effects on uterine contractility: Estrogen increases contractility, and progesterone decreases it.
 - Downregulation of the progesterone hormone receptors contributes to parturition. **Its level does not increase** so that estrogen overtakes it.
2. **Placenta stimulates the secretion of CRH** hormone by the hypothalamus or **secretes it itself**. This hormone **increases the ACTH** hormone in the pregnant woman. It also **increases cortisol** which is important during labour.



3. **Estrogen stimulates** (and progesterone inhibits) **local production** of the **prostaglandins PGE₂ and PGF_{2α}**. Thus the increasing estrogen/progesterone ratio stimulates local prostaglandin production.

- **Prostaglandins increase the intracellular calcium** concentration of uterine smooth muscle, thereby **increasing its contractility**.
- Prostaglandins also **promote gap junction formation** between uterine smooth muscle cells to **permit synchronous contraction** of the uterus.
- Prostaglandins cause **softening, thinning** (effacement), and **dilation** of the **cervix** early in labor.
- **PGF 2 alpha causes luteolysis**.

4. Oxytocin is a powerful stimulant of uterine contractions (indeed, it is used to induce labor).

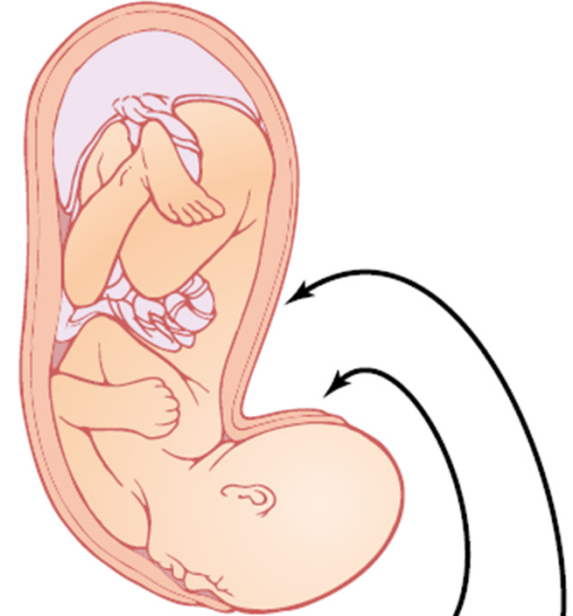
- However, maternal blood levels of oxytocin do not increase near term.
 - **physiologic role of oxytocin is uncertain.**
 - But, The uterine muscle **increases its oxytocin receptors** and therefore **increases its responsiveness** to a given dose of oxytocin during the latter few months of pregnancy.
 - The rate of oxytocin secretion by the neurohypophysis is considerably **increased at the time of labor.**
 - hypophysectomized animals can still deliver their young at term, labor is prolonged.
 - irritation or stretching of the uterine cervix, can cause a **neurogenic reflex** through the paraventricular and supraoptic nuclei of the hypothalamus that causes the **posterior pituitary gland** (the neurohypophysis) to **increase its secretion of oxytocin.**

Events that may contribute to parturition

Positive feedback theory → 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.

- This pushes the baby forward, which stretches the cervix more and initiates more positive feedback to the uterine body. Thus, the process repeats until the baby is expelled.

بالعربي من بداية الحمل يكون في انقباضات خفيفة كل مرة بصير فيها انقباض بيحي وراه انقباضة اقوى ، اثناء الولادة بتصير العملية مع انقباضات قوية وبتناغم معين " الطلق، سمّي بذلك لأنه مؤلم كالم الإصابة بالرصاص واكثر " المهم الطلقة بتجيب وراها وحدة اكبر لحد ما الجنين يندفع باتجاه قناة الولادة...



1. Baby's head stretches cervix
2. Cervical stretch excites fundic contraction
3. Fundic contraction pushes baby down and stretches cervix some more
4. Cycle repeats over and over again

Theory for the onset of intensely strong contractions during labor.

Stages of normal labor

• اقرؤوا هاي الجزئية من الكتاب صفحة 1065 وتكملة الكلام المظلل

- **First stage/rapid uterus contractions:**
 - a period of progressive cervical dilatation.
 - Uterine contractions **originating at the fundus** and sweeping downward move the head of the fetus toward the cervix and **progressively widen and thin the cervix**.
 - Ends when the cervical opening is large as the size of fetus head
 - It lasts for **8-24 hours in the first pregnancy**, but often **only few minutes after many pregnancies**



- **Second stage:**

- **Once the cervix is fully dilated, fetal membranes rupture and the amniotic fluid is lost suddenly through the vagina.**

هاي بالعامية بسموها " نزول ماء الرأس "

- Rupturing of the fetal membrane stimulates contractions and helps the passage of the fetus..
- The fetus's head moves rapidly into the birth canal until **it is forced through the cervix and delivered through the vagina.**
- May last 30 minutes or more in the first pregnancy and as little as 1 minute after many pregnancies.



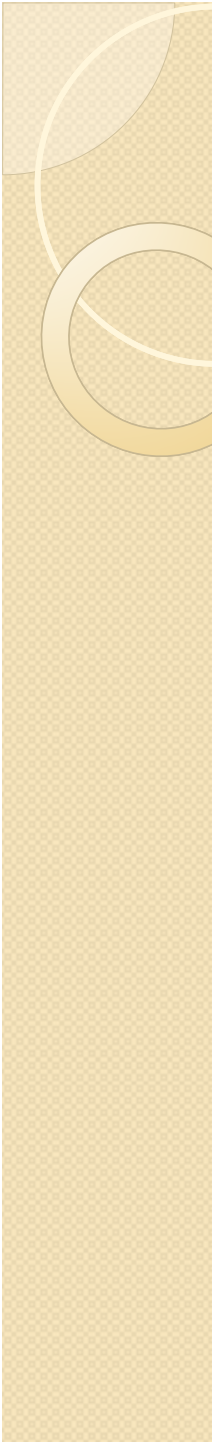
- **Third stage:**

the **placenta separates from the uterine** decidual tissue and is delivered.

- Separation of the placenta opens placental sinuses and causes **bleeding**. The amount of bleeding is limited to 350 ml by :
 - **powerful contractions of the uterus** also serve to **constrict uterine blood vessels** and **limit postpartum bleeding**.
- **(10-45 minutes)**
- After delivery of the placenta, hormone concentrations return to their prepregnant levels, except for **prolactin**, whose levels remain high if the mother breastfeeds the infant.



Lactation

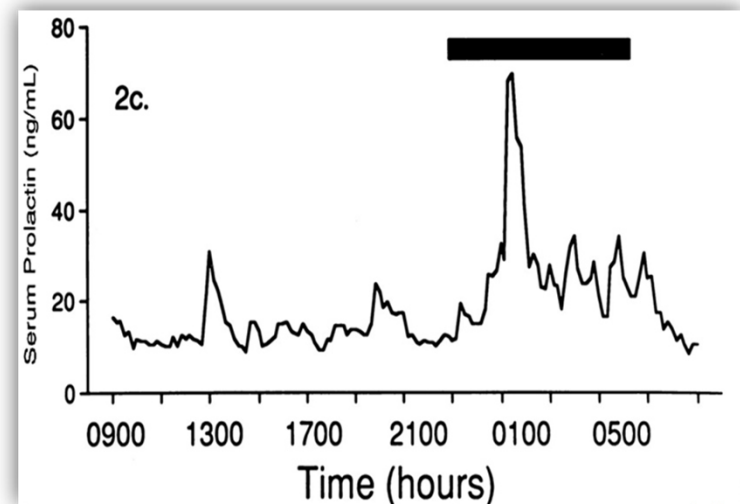
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- Throughout pregnancy, **estrogen and progesterone** stimulate the **growth and development of the breasts**, preparing them for lactation.
 - Estrogen also stimulates **prolactin** secretion by the **anterior pituitary**, and **prolactin levels steadily increase** over the course of pregnancy (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** to promote milk secretion
 - However, although prolactin levels are high during pregnancy, **lactation does not occur** as progesterone blocks the action of prolactin on the breast.
 - Milk secretion initiation by **prolactin + cortisol + insulin + growth hormone** by:
 - to **start milk genes transcription...** Growth of ductal system in breast
 - With **PTH** to provide **amino acids, fatty acids, glucose and calcium** that are required for milk formation..
 - Lactation is maintained by **suckling**, which **stimulates** the secretion of both: **oxytocin** and **prolactin**.

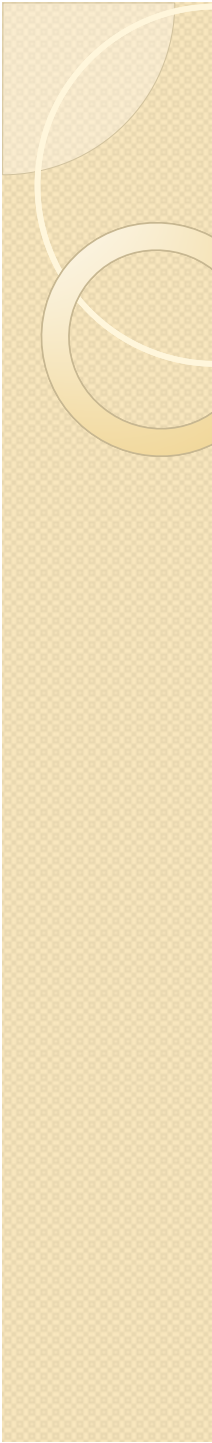
Prolactin

- Peptide hormone synthesized by **lactotrophs** in **anterior pituitary gland**.
- Prolactin promotes mammary gland development and milk production.
- Secreted in a **pulsatile fashion** (about 14 pulses per day in the late follicular phase to about 9 pulses per day in the late luteal phase).
- Diurnal variation with the lowest levels occurring the midmorning after the patient awakes. Levels **rise 1 hour after the onset of sleep**.. **Things that maintained this pulsatile are:**
 - **Dopamine:** Hormone that inhibits (controls) prolactin
 - **Prolactin-releasing hormone:** secreting by the hypothalamus to stimulate prolactin syntheses and secretion

❑ Each time the mother nurses her baby, nervous signals from the nipples to the hypothalamus cause a **10- to 20-fold surge in prolactin secretion** that lasts for about 1 hour.

❑ If this prolactin surge is absent or blocked, the **breasts lose their ability to produce milk within 1 week**.



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- **Prolactin is a nature contraceptive:**
 - As long as lactation continues, there is **suppression of ovulation** because prolactin:
 - **inhibits GnRH secretion** by the **hypothalamus**
 - **Inhibits the action of GnRH on the anterior pituitary** → inhibits FSH and LH secretion
 - **Antagonizes the actions of LH and FSH on the ovaries.**
 - **It stops the maturation and rupturing of the dominant follicle.**
 - **No ovulation or menstrual cycle**
 - For prolactin to be effective in preventing pregnancy, there needs to be a **regular breastfeeding cycle**. An irregular cycle/depending on bottle feeding means: **prolactin is not high enough** to prevent pregnancy.
 - Abnormally high levels of prolactin lead to infertility

Effects of oxytocin on milk ejection

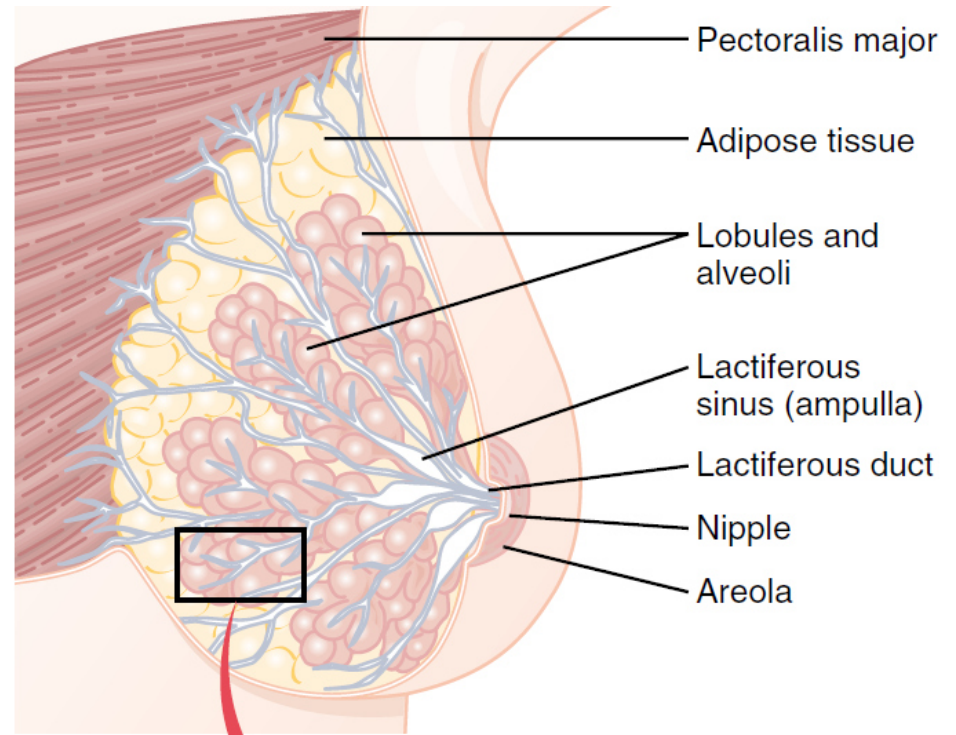
- It's responsible of ejection/let-down process in milk secretion.

Suckling stimulus mechanoreceptors on the nipple of the breast → send **signals**, which transmitted through **sensory nerves to the oxytocin neurons** in the paraventricular and supraoptic nuclei in the **hypothalamus** → release of **oxytocin by the posterior pituitary gland** → oxytocin carried by blood to the breasts → **contraction of myoepithelial cells**. (which surrounds the outer walls of the alveoli), then injection of the milk through ducts to the nipple to the baby....

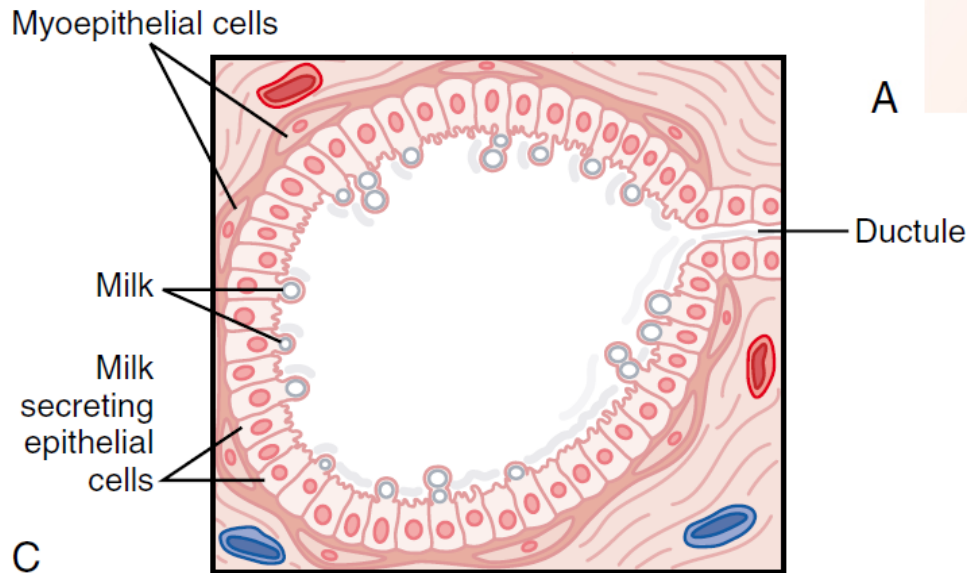
- That's happened after ½ to 1 min. after the baby start suckling (without suckling the milk will not flow)...

- عالهامش، الاوكستوسين هو هرمون الأمومة، ممكن الأم المرضعة تشتاق لطفلها او تشوف طفل بعمره فينسكب حليب منها من دون عملية ال suckling

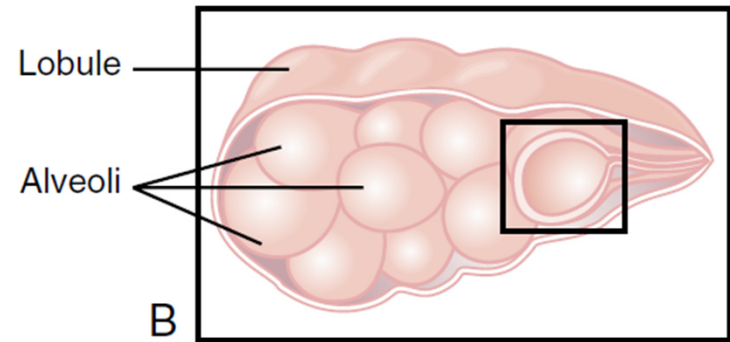
Effects of oxytocin on milk ejection



A

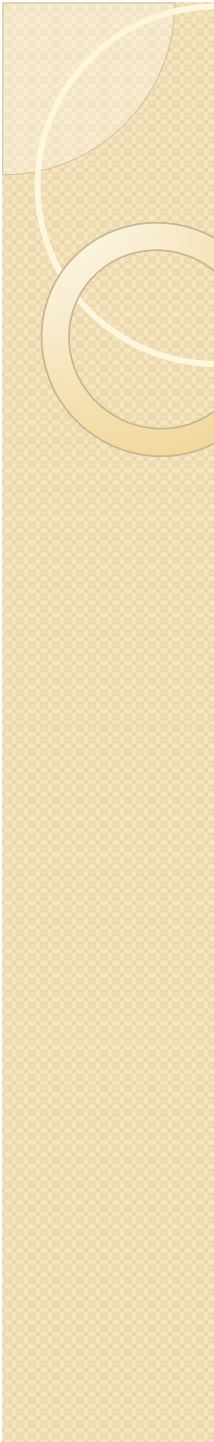


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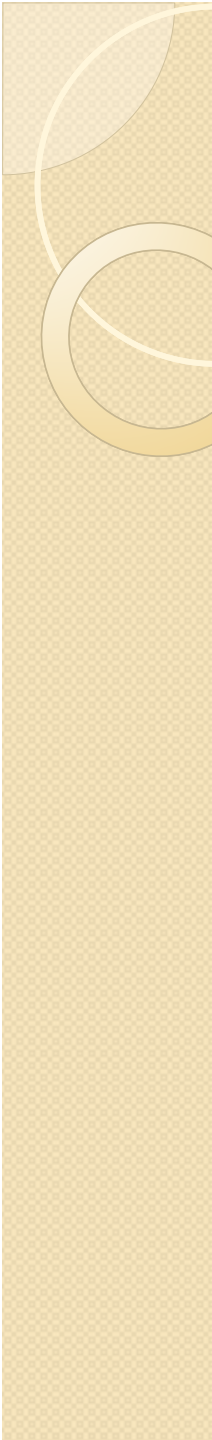
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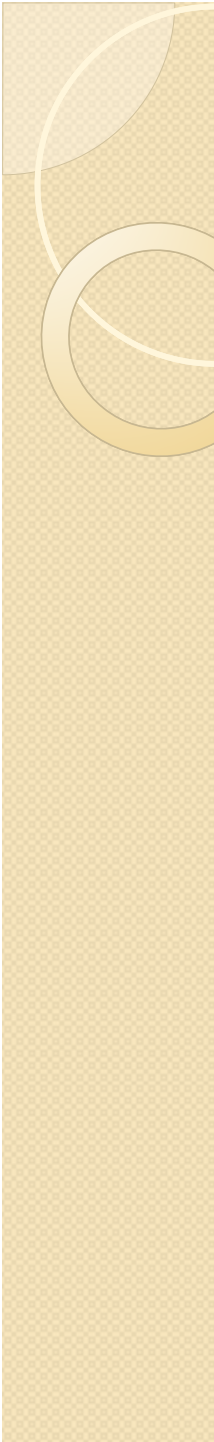
Figure 82-10 The breast and its secretory lobules, alveoli, and lactiferous ducts (milk ducts) that constitute its mammary gland (A). The enlargements show a lobule (B) and milk-secreting cells of an alveolus (C).

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- **Colostrum**, first form of milk produced by the mammary glands **during the first week of lactation** is important since it **supplies the infant with many nutrients, antibodies**
 - It contains huge amount of **IgG, IgM, minerals and antioxidant vitamins** such as **vitamin A and C**, also it has an important immune-stimulating protein called **Lactoferrin**



Menopause

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- **Menopause**, or the climacteric, is the cessation of menstrual cycles in women.
 - It occurs at approximately 45- 50 years of age .
 - For several years preceding menopause, anovulatory cycles (menstrual cycles in which ovulation does not occur) become more common and the **number of functioning ovarian follicles decreases**. (the ovarian reserve is not enough for ovulation)
 - Accordingly, estrogen secretion gradually declines and eventually ceases... a little amount of estrogen still synthesizes from adrenal cortex and adipose tissue converting process
 - Because of the decreased level of estrogen → reduced negative feedback on the anterior pituitary → **increased secretion and pulsatility of FSH and LH at menopause**.
 - The **earlier menopause** starts (<45), and those females have **higher risk** for **osteoporosis** and **colorectal cancer** (give hormone replacement therapy to lower the risks).

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- The symptoms of menopause are caused by the loss of the ovarian source of estrogen. They include:
 - thinning of the vaginal epithelium
 - decreased vaginal secretions
 - decreased breast mass
 - accelerated bone loss
 - vascular instability (“**hot flashes**”) :an increase in womens core temperature due to a **decrease in the set point of temperature** in the **hypothalamus**. It happens between **1-5 years until the body adapts to this change**.
 - emotional lability.
 - Why are **obese women less effected by estrogen withdrawal** than slimmer women? Because estrogen can be produced from **androgenic precursors in adipose tissue**, obese women tend to be less symptomatic than nonobese women.