

1) Pregnancy:

- Placenta secretes **5** hormones: hCG, HCS (or HPL), estrogen, progesteron, + relaxin

- hCG is secreted by **syncytial trophoblasts** of placenta.

- hCG prevents menstruation.

- hCG levels:

1) (8-9 days after ovulation) found in **blood**.

2) Peak: 10th **week** pregnancy.

3) decreases 16-20th **week** pregnancy. Then remains LOW till end of pregnancy.

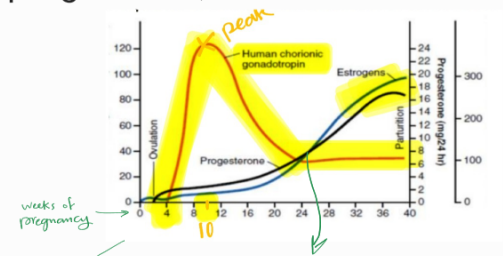
- hCG functions:

1) maintains corpus luteum till week 13-17 (then estrogen & prog. are secreted by placenta).

2) LH like func.: stimulates leydig to secrete testosterone in male fetuses (sex organs growth).

** Note: after birth testosterone is secreted by testis, to help their descending.

* No corpus leuteum = spontaneous abortion.



- Estrogen is secreted by **syncytial trophoblasts** of placenta (30X)

- Estrogen is derived from DHEA (weak androgen), not cholesterol, cause no aromatase in placenta.

- Estrogen func.:

1) activation of uterus. (Gap junc dev).

2) enlzrgement of female sex organs

3) relaxation of pelvic ligaments → labor.

- progesteron is secreted by **syncytial trophoblasts** of placenta (10X)

- derived from cholesterol.

- by corpus luteum (low amount), then by placenta (high).

Func:

- decidual cells development (for nutrition of early embryo).

- conceptus development (nutrition for the developing morula and blastocyst).

- cell cleavage in the early developing embryo.

- preparing breasts for lactation

- HCS OR HPL:

- Amount is greater than that of all the other pregnancy hormones.

- Secreted at 5th week G.

Functions: (**metabolic**)

1- Breast development (cannot induce milk in human).

2- Weak **GH** action (100x less)

3- Inhibits **insulin** sensitivity = ↓ Glu utilization by mother (increase it in fetus instead).

4- Promotes release of **FA**.

- Relaxin is Secreted by **corpus luteum and placenta**.

Functions:

A- Relaxation of symphysis pubic ligament (weak)

B- Softens the cervix at delivery.

C- vasodilator.

Changes during preg:

- Anterior pituitary gland enlargement (50%) → increase releasing of ACTH, TSH and PL.
- FSH and LH are almost totally suppressed (due to high levels of estrogen & progesterone).
- Adrenal gland Increases glucocorticoids secretion → mobilization of AA to fetus.
- + aldosterone (2X) → pregnancy-induced hypertension).
- Thyroid gland enlargement (50%) → increases in thyroxine production → increase the metabolic rate, also there are some thyrotropic effects of HCG, TSH, and placental human chorionic thyrotropin
- Parathyroid gland enlargement → Increase PTH secretion → ossify bones of fetus.

Others:

- Increase in uterine size. -The breast doubles in size. -The vagina enlarges.
- edema and acne. -Increase in appetite -Masculine or acromegalic features (overall growth).
- Weight gain 10-12 kg (last 2 trimesters) (~4kg fetus) due to: weight of fluid (amniotic fluid + increased retention of water) and increased fat deposition.
- renal tubules' reabsorption of Na⁺, Cl⁻, & water, because of:
 - A- cortical and placenta steroid hormones.
 - B- The renal blood flow and GFR.
 - C- Tubuloglomerular feedback.
 - D- NO or relaxin.

- basal metabolic rate (15%) due to thyroxine, ACTH and sex hormones actions.
- in daily requirements for Iron, Phosphates, Ca⁺⁺ and Vitamins - vitamin D.
- blood flow through the placenta
- blood volume due to:

1-Increased aldosterone and estrogen which increases ECF.

2- Increased activity of the bone marrow.

3- increased fluid retention

- 1-2 L of extra fluid are obtained.

→ Blood Flow and Cardiac Output during 27th week.

-the cardiac output falls in the last 8 weeks of pregnancy.

Because the blood flow in some other tissue(s) may be reduced.

- O₂ consumption (20%)
- respiratory rate (RR) due to:

A- Progesterone ↑ sensitivity of respiratory center to CO₂.

B- the growing uterus presses upward against diaphragm..

****As a result, an increase in minute ventilation by 50% & a decrease in arterial PCO₂.**

- water in amniotic fluid is replaced once every 3 h, while electrolytes are replaced once every 15h.

-amniotic membranes contribution (cause even when the fetus dies, amniotic fluid turnover still takes place).

- A large portion of the fluid is derived from renal excretion by fetus.

1-PREECLAMPSIA

- pregnancy-induced **hypertension**.
- during the **last few months** of pregnancy.
- associated with **proteinuria**.

1-Excess salt and water retention.

2-Weight gain, edema, and hypertension.

3-Vascular endothelial function is impaired and arterial spasm in kidneys, brain, liver, ..

4-decreased renal blood flow and GFR.

- Theories: hormonal | AI | cytokines | impaired angiogenesis.

Mechanism (theories): 1-excessive secretion of placental or adrenal hormones.
2- some type of **autoimmunity** or allergy in the mother caused by fetus.
Evidence : Preeclampsia is initiated by insufficient blood supply to the placenta early in pregnancy, resulting in the placenta's release of substances that cause widespread vascular dysfunction to the mother → **This takes place when trophoblasts invade the endometrium inducing changes in endometrial arterioles in order to get larger and provide enough blood supply to the developing fetus. So, when maternal arterioles fail to undergo adaptive changes, the blood supply would not be sufficient forcing the placenta to release harmful substances to the vasculature of the mother.
3- increased levels of inflammatory cytokines such as TNF- α and IL-6.
4- Placental factors that **impede angiogenesis** (blood vessel growth) has a role.

2-ECLAMPSIA:

- an extreme degree of preeclampsia → Vascular spasm, Clonic seizures, coma.
- Great decrease in kidney output; Liver malfunction; Extreme hypertension.
- generalized toxic condition of the body. (Very serious)
- shortly before birth.
- death

Rx: rapidly acting **vasodilating** agent drugs, followed by **termination of the pregnancy**.

2) Parturition:

Hormonal Factors:

1- Increased Ratio of Estrogens to Progesterone.

*estrogens increase the No. of gap junctions btw uterine smooth muscles.

*From the 7th month, estrogen secretion continues to ↗ while progesterone secretion remains constant or decreases.

2- Oxytocin

*uterine muscle increases its oxytocin receptors.

*rate of oxytocin secretion by the neurohypophysis is increased.

*hypophysectomized animals (in experiments) can still deliver at term, labor is prolonged.

*Experiments in animals indicate that irritation of cervix causes a neurogenic reflex through the paraventricular & supraoptic nuclei of the hypothalamus causing secretion of oxytocin.

3- Fetal Hormones: **oxytocin, PGs, corticosteroids** (all ↗ contraction).

MECHANICAL FACTORS:

1- Stretch of Uterine Muscles.

*Twins average 19 days **earlier** than a single child-> due to further uterine stretch.

2- Stretch/Irritation of Cervix:

*due to neural reflexes to the body of the uterus or could be only myogenic transmission of stretch from the cervix to the uterus.

*obstetricians frequently induce labor by rupturing the fetal membrane so the head of the baby stretches the cervix.

- LABOR, A POSITIVE FEEDBACK MECHANISM FOR ITS INITIATION.

- During most pregnancy months → Braxton Hicks contractions (weak, slow, rhythmic).
- By the end of pregnancy: → labor contractions.
- *positive feedback theory: stretching of cervix by fetus's head finally becomes great enough to elicit a strong reflex (a positive loop), through:
 - 1- Automatic response for uterus smooth muscles
 - 2- Initiating a nerve impulse transmitted to brain → post. pituitary → oxytocin.
- 2 types of +ve feedback increase uterine contractions during labor:
 - (1) Stretching of the **cervix** causes the entire body of the **uterus** to contract.
 - (2) Stretching of the **cervix** causes the pituitary gland to secrete **oxytocin**.
- Neurogenic reflexes in the spinal cord to abdominal muscles, causing them to intensely contract, which add up to uterine contractions.

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- Early at labor, contractions occur once every 30 min.
 - **Rule of 4-1-2** → uterine contractions are 4 min apart last for 1 min that occur in rhythm for at least 2 h. = labor = hospital.
 - As labor progresses, the contractions become stronger, once every 1- 3 min.
 - ** **intermittent, not strong** contractions because strong ones could stop blood flow through the placenta causing death of the fetus
 - Normal labor: head is the first part to be expelled,
 - In remaining instances, buttocks or the feet are presented first (**breech presentation**).
 - Labor stages:
 - 1) a period of progressive **cervical** dilation, until (**complete effacement**).
 - *lasts for 8-24 h in the 1st pregnancy, few min after many pregnancies.
 - *fetal membranes will rupture, & amniotic fluid is lost suddenly through vagina.
 - 2) the **head** of the fetus moves rapidly through the birth canal.
 - *last for 30 min or 1 min after many pregnancies.

LABOR, SEPARATION AND DELIVERY OF THE PLACENTA:

- The uterus continues to contract for (10-45) minutes after birth → separating the placenta → bleeding 350 ml,
- * bleeding doesn't last for long time, because:
 - 1- uterine smooth muscle fibers are arranged in **figures of eight** around the blood vessels through the uterine wall so when they contract, they **block the vessel**.
 - 2- **vasoconstrictor prostaglandins** formed at placental separation site.

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- **In early labor**, pain is due to **hypoxia** of uterine muscles due to compression of uterine blood vessels. Via visceral sensory **hypogastric nerves** (carry visceral sensory fibers from the uterus).
 - **During the 2nd stage of labor**, more severe pain by cervical, vaginal, & perineal **stretching**. Via **somatic nerves**.

Postpartum bleeding (10-40 days):

- due to vaginal discharge (**lochia**).
- first **bloody**, then **serous**.

LACTATION:

- Required hormones : Estrogens, Progesterone, Prolactin, Adrenal glucocorticoids, PTH Insulin and Growth hormone.

- **Estrogens** Stimulate **Growth** of the **Ductal System** of the Breasts.

- **Progesterone** is required for **full development** of the **Lobule-Alveolar System**, & final development of breasts into milk-secreting organs.

Progesterone acts synergistically with estrogen & with the other hormones.

PROLACTIN is the primary hormone that PROMOTES LACTATION.

- Secreted by **anterior** pituitary.

- rises steadily from the **5th week** pregnancy until birth.

- Before birth: **prolactin** secretion goes parallel with estrogen & progesterone secretion → suppressive effects → low amounts of milk.

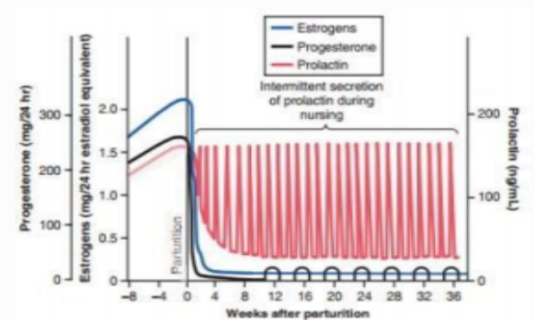
- After birth: sudden loss of estrogen & progesterone secretion → high amounts of milk.

- In addition, the placenta secretes large quantities of **HCS** (has lactogenic properties), supporting prolactin.

- **Colostrum**: Secretions in the last few days before & the first few days after parturition.

It has the same concentrations of proteins & lactose as milk, but **no fat**, & its maximum rate of secretion is **1/100** the subsequent rate of milk production. Also, it is rich with **immunoglobulins**.

- basal level of prolactin secretion returns to the nonpregnant level during the next few weeks after delivery, but with some fluctuations because of the Nervous signals sent from the nipples to the hypothalamus, causing a (10-20) fold surge in prolactin secretion that lasts~ 1 h, whenever the baby suckles the breast.



PROLACTIN INHIBITORY HORMONE-HYPOTHALAMUS:

- It controls prolactin secretion.

- The catecholamine **Dopamine**, (secreted by hypothalamus) can decrease prolactin secretion as much as 10-fold.

- 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. Because Prolactin is inhibited by a factor transported through the hypothalamic-hypophysial portal system to the anterior pituitary gland.
- This factor is the catecholamine **Dopamine**, which is secreted by the arcuate nuclei of hypothalamus and can decrease prolactin secretion as much as 10-fold.
The hypothalamus controls prolactin secretion by inhibiting prolactin production

- same nervous signals from the breasts to the hypothalamus that cause prolactin secretion inhibit secretion of GnRH by the hypothalamus → inhibition of LH & FSH secretion → inhibition of ovarian cycle.

- after several months of lactation, the pituitary begins to secrete sufficient gonadotropic hormones → reinstatement of the sexual cycle.

EJECTION (OR "LET-DOWN") PROCESS IN MILK SECRETION—FUNCTION OF OXYTOCIN:



- caused by a combined neurogenic & hormonal reflex that involves the posterior pituitary hormone Oxytocin.

(prolactin: ant pituitary, oxytocin: post pituitary).

- baby suckles → Sensory impulses through somatic nerves from nipples to spinal cord then to hypothalamus → oxytocin secretion, **at the same time** → prolactin secretion.

- oxytocin causes myoepithelial cells to contract,
- within 30 seconds to 1 minute after a baby begins to suckle, milk begins to flow.
- 1.5 L of milk every day.
- If mother's diet was lacking Calcium or Vit D, the parathyroid glands enlarge, & the bones become decalcified.
- Multiple types of Antibodies, anti-infectious agents, & WBCs are secreted in milk.

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

قُلْ لِلفؤَادِ إِذَا تَعَاظَمَ كَرِبَةٌ 
 رَبِّ الفؤَادِ بِلطفِهِ يَرعَانِي 

 الحمد لله