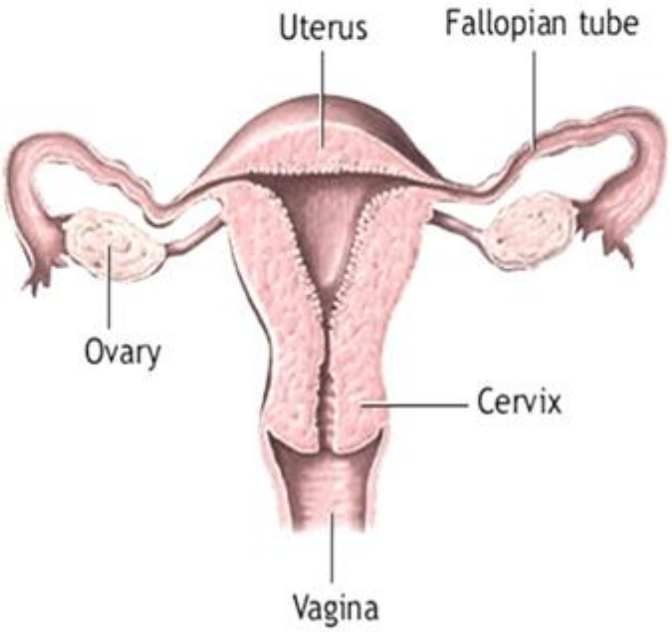
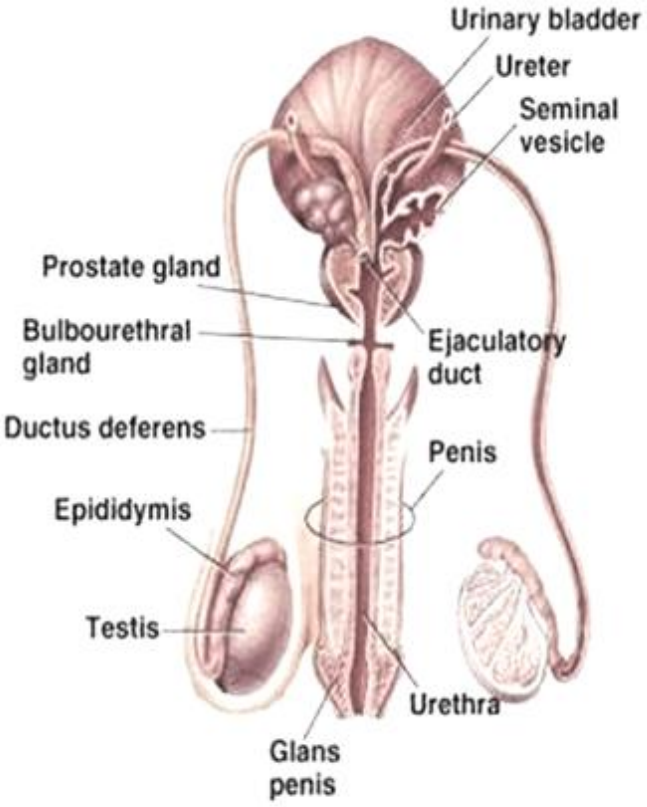
Reproductive Block

7th Lecture

Physiology of Labor





PHYSIOLOGY TEAM – 430

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☒ Parturition :

- **Definition:**

- Uterine contractions that lead to expulsion of the fetus to extrauterine environment
- Towards the end of pregnancy the uterus become progressively more excitable and develops strong rhythmic contractions that lead to expulsion of the fetus.
- Uterus is spontaneously active, it contracts continuously, sometimes women can feel it.
- Spontaneous depolarization of pacemaker cells , these cells send impulses through gap junctions. (just like the heart).
- Gap junctions spread depolarization.
- Exact trigger is unknown : there are hormonal and mechanical changes at the end of pregnancy , these changes lead to delivery.

✓ Hormonal changes
✓ Mechanical changes

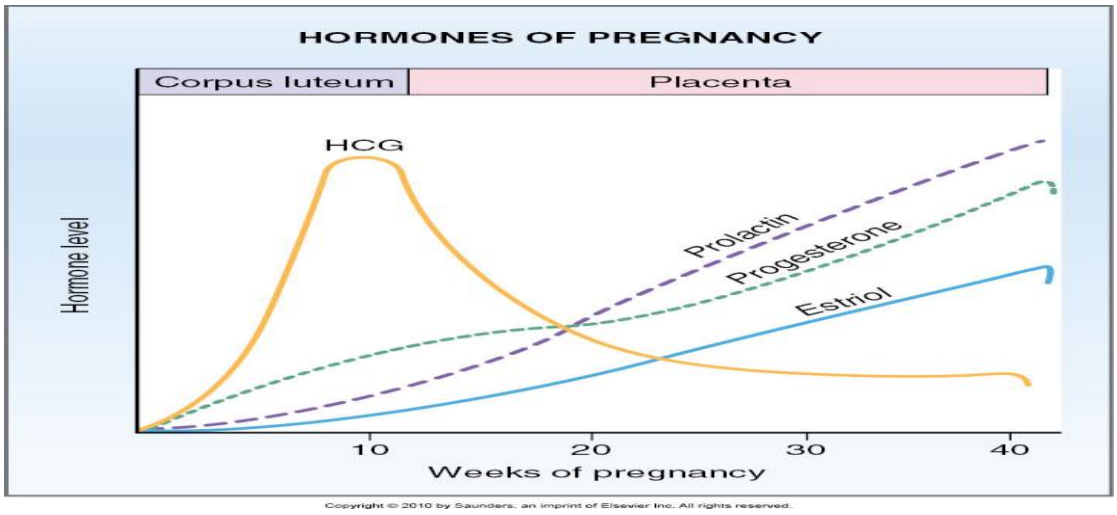
☒ Hormonal changes:

- **Estrogen/Progesterone ratio:**

- Estrogen stimulates uterine contractility by ↑ GAP junctions with onset of labour , ↑ Oxytocin receptors and local oxytocin production , ↑ Prostaglandins synthesis (prostaglandin is released locally from the fetus membranes).
- Progesterone inhibits uterine contractility and promotes uterine inactivity during pregnancy. (opposite of estrogen)

- **From 7th month till term:**

- Progesterone secretion remain constant
- Estrogen secretion continuously increases
- Increase estrogen/progesterone ratio



Progesterone	Estrogen
↓ GAP junctions	↑ GAP junctions with onset of labour.
↓ Oxytocin receptor	↑ Oxytocin receptors.
↓ Prostaglandins.	↑ Prostaglandins
↑ resting membrane potential	

- **Oxytocin:**

- Dramatic Increase of oxytocin receptors (200 folds) during late pregnancy by the action of estrogen.
- Gradual transition from passive relaxed to active excitatory muscle (↑responsiveness).
- Increase in oxytocin secretion at labor due to cervical stimulation by the head of the fetus
- Oxytocin increases uterine contractions by:

✓ **Directly:** by stimulating its receptors

✓ **Indirectly:** by stimulating prostaglandin production.

- Oxytocin receptors increase during late pregnancy
- Oxytocin secretion increases at labour.

- **Prostaglandins:**

- Central role in initiation & progression of human labour
- Locally produced (intrauterine)
- Oxytocin and cytokines stimulate its production, mainly type "F" which is the most important one for labour.
- Prostaglandin stimulate uterine contractions by:

✓ **Direct effect:**

- Through their own receptors
- Upregulation of myometrial gap junctions

✓ **Indirect effect:**

- Upregulation of oxytocin receptors

Prostaglandin E2 has 4 types of receptors, two receptors have contraction effect on the fetus and the other two have relaxing effect on the lower part of the uterus. So prostaglandin E2 has both contraction and relaxation effects.

☒ Mechanical changes:

- **Stretching the muscle of the uterus** Increases contractility:

✓ Fetal movements stimulate contraction.

✓ Multiple pregnancy

- **Stretching of the cervix (causes oxytocin release)** Increases contractility (reflex):

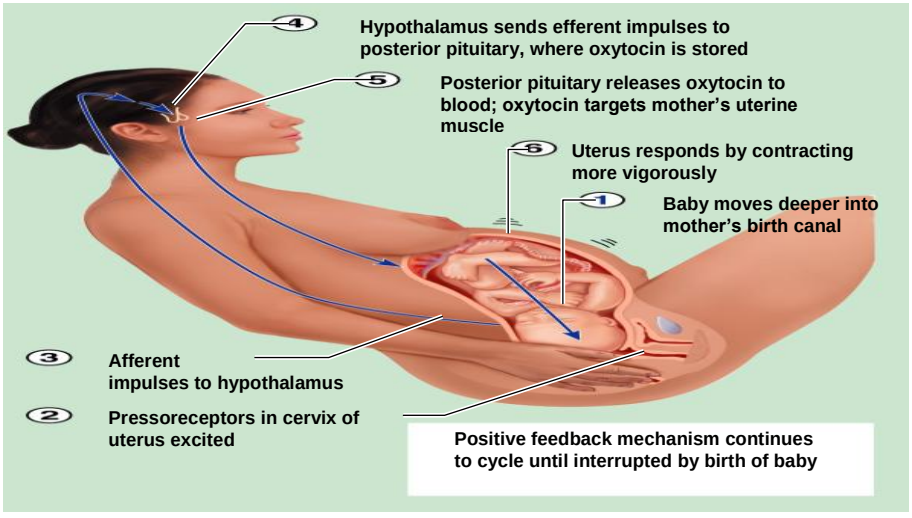
✓ Membrane sweeping & rupture (induction contraction).

✓ Fetal head activates oxytocin release by pressing against the cervix.

Positive feedback mechanism

Positive feedback mechanism: During labour, oxytocin levels rise due to cervical stimulation by the head. It stimulates uterine contractions that push the fetus against the cervix which stimulates more oxytocin release.

☒ Initiation of Labor



Labour is the sequence of actions leading to parturition. Labour is divided into 3 stages (discusses later), while parturition is divided into 4 phases.

☒ Phases of parturition:

- **Phase 0**
- From conception to beginning of labor. uterus is relaxed (quiescent)
- **Phase 1**
- Activation: expression of contraction proteins (more receptors and more gap junctions)
- **Phase 2**
- Stimulation: stage 1 & stage 2 of labor
- Cervical dilatation & expulsion of fetus
- High oxytocin and prostaglandin release.
- **Phase 3**
- Stage 3 of labor.
- Delivery of the placenta and uterine involution.

➢ Phase 0 : Quiescent uterus (relaxed uterus)

- Associated with increased cAMP, cGMP, which leads to decrease in Ca & MLCK activity due to Increase in production of progesterone, relaxin, prostacyclin, PTH-related peptide, NO (all inhibitors) which cause uterine relaxation.

➢ Phase 1 : Activation of uterus (prepares the uterus for delivery)

- Occurs in third trimester
- The release of uterotrophins (estrogen, progesterone, Prostaglandins, CRH) increases the size of the uterus and activates the uterus.
- Increase excitability & responsiveness to stimulators by:

✓ Increase expression of gap junctions

✓ Increase G protein-coupled receptors:
Oxytocin receptors
Increase PGF receptors

- Upregulation of contraction-associated proteins - connexin-43
- Increase gap junctions - 50X increase myometrial oxytocin receptor
- Uterus responsive to uterotonins (contraction)
- Dilation and effacement of cervix, cervical softening due to rearrangement of collagen fibers, glycosaminoglycans

➢ Phase 2 : Stimulation of uterus (during delivery – baby delivered)

- Occurs in last 2-3 gestational weeks
- Increase in synthesis of: Cytokines - Prostaglandins – Oxytocin
- Includes 2 stages of labour : Stage 1 - Stage 2

➢ Phase 3 : Uterine involution (after delivery)

- Pulsatile release of oxytocin
- Delivery of the placenta
- Involution of the uterus:

✓ Occurs in 4-5 weeks after delivery

✓ Lactation helps in complete involution

The blood vessels become very wide in phase 3, the separation of the fetus from the mother stimulates a very strong contraction that blocks these blood vessels and prevents heavy bleeding from happening.

Involution of the uterus prevents heavy bleeding after delivery.

☒ Miscellaneous issues:

Braxton-Hicks contractions:

- Labour begins with regular, painful uterine contractions accompanied with cervical dilation.
- True labour is often preceded by several weeks of false labour with irregular painful contractions called Braxton-Hicks contractions with NO cervical dilation.
- Braxton-Hicks contractions are irritability of uterine muscle – weak & slow contractions – begin about 1 month before labor.
- In contrast: stronger contractions stretch cervix and force baby through birth canal
- True labor has circadian rhythym:
  Peaks between 12 midnight and 5 am
- "labor pains" : due to ischemia of uterine muscle in early stage, then stretch of cervix, perineum, vagina

☒ Mechanism of parturition

- Contractions start at the fundus and spreads to the lower segment
- The intensity of contractions is strong at the fundus but weak at the lower segment
- In early stages 1 contraction/ 30 minuets
- As labor progress 1 contraction/ 1-3 minutes
- Abdominal wall muscles contract
- Rhythmical contractions allows blood flow

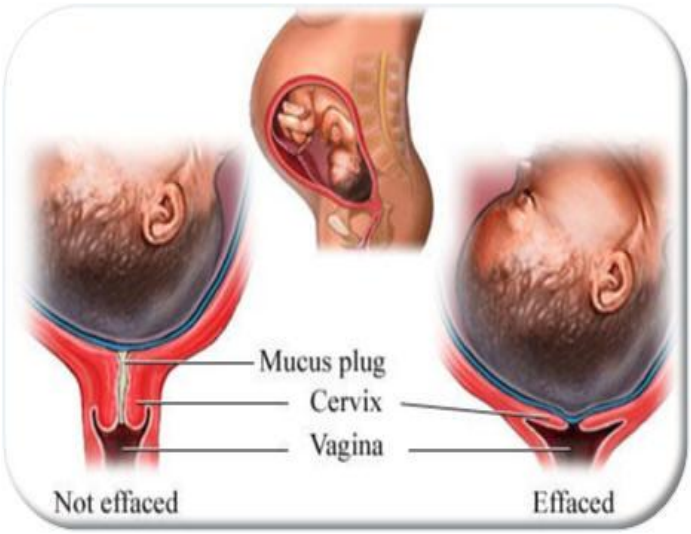
✓ Labor and Parturition:

- **Parturition:** Denotes the whole process by which the baby is born.
- **Labor:** Strong uterine contractions, cervical dilatation, forcing the fetus through the birth canal

☒ Onset of labor:

- **During pregnancy:**
- Periodic episodes of weak and slow rhythmical uterine contractions (Braxton Hicks)
- 2nd trimester
- **Towards end of pregnancy:**
- Uterine contractions become progressively stronger & regular suddenly uterine contractions become very strong leading to: Cervical effacement and dilatation

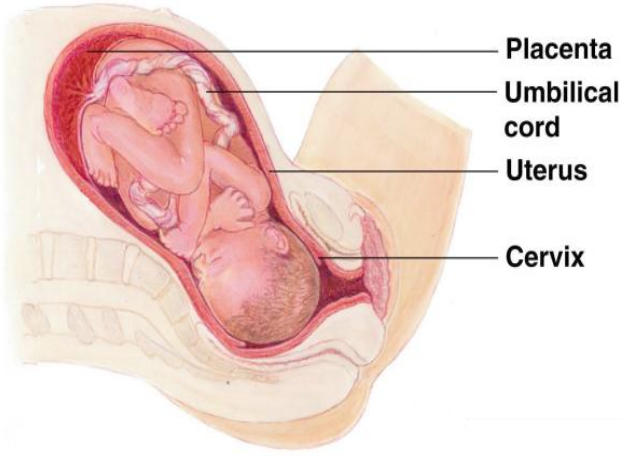
Cervical effacement:
Effacement is the process by which the cervix prepares for delivery. After the baby has engaged in the pelvis, it gradually drops closer to the cervix; the cervix gradually softens, shortens and becomes thinner. You may hear phrases like "ripens," or "cervical thinning" which refers to effacement.



☒ Stages of labor:

- **Stage 1: Dilation:**

- Commences with the onset of labour and terminates when the cervix has reached full dilatation and membranes ruptured (lasts 8-24 hours).
- Uterine contractions begin and increase
- Cervix softens and effaces (thins)
- Cervix becomes dilated
- The amnion ruptures ("breaking the water")
- Longest stage at 6–12 hours



① **Dilation of the cervix**

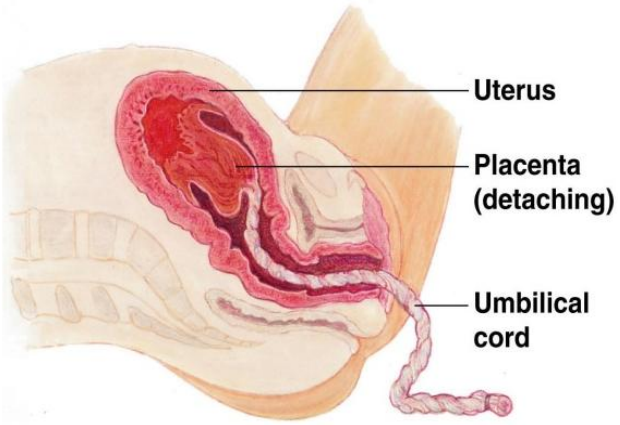
- **Stage 2: Expulsion:**

- Stage of expulsion begins at full cervical softening and dilatation and ends with expulsion of the fetus (lasts 1-30 minutes).
- Infant passes through the cervix and vagina
- Can last as long as 2 hours, but typically is 50 minutes in the first birth and 20 minutes in subsequent births
- Normal delivery is head first (vertex position)
- Breech presentation is buttocks-first
- Prolonged second stage might cause mental retardation for the delivered baby.

② **Expulsion: delivery of the infant**

- **Stage 3: Placental**

- Begins with the delivery of the child and ends with the expulsion of the placenta.
- Delivery of the placenta
- Usually accomplished within 15 minutes after birth of infant
- Afterbirth - placenta and attached fetal membranes
- All placental fragments should be removed to avoid postpartum bleeding



③ **Delivery of the placenta**