

Pregnancy and Lactation-1

Chapter 83
Unit X1V

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Maturation and fertilization of the ovum

Secondary oocyte+ granulosa cell (corona radiata)



Ovulation



Peritoneal cavity



Cilia activation by estrogen



Beating toward ostium of FT



Ova enters fimbriated end of one of FT



Secondary oocyte at mpullae of FT ← **Sperm**



fertilization

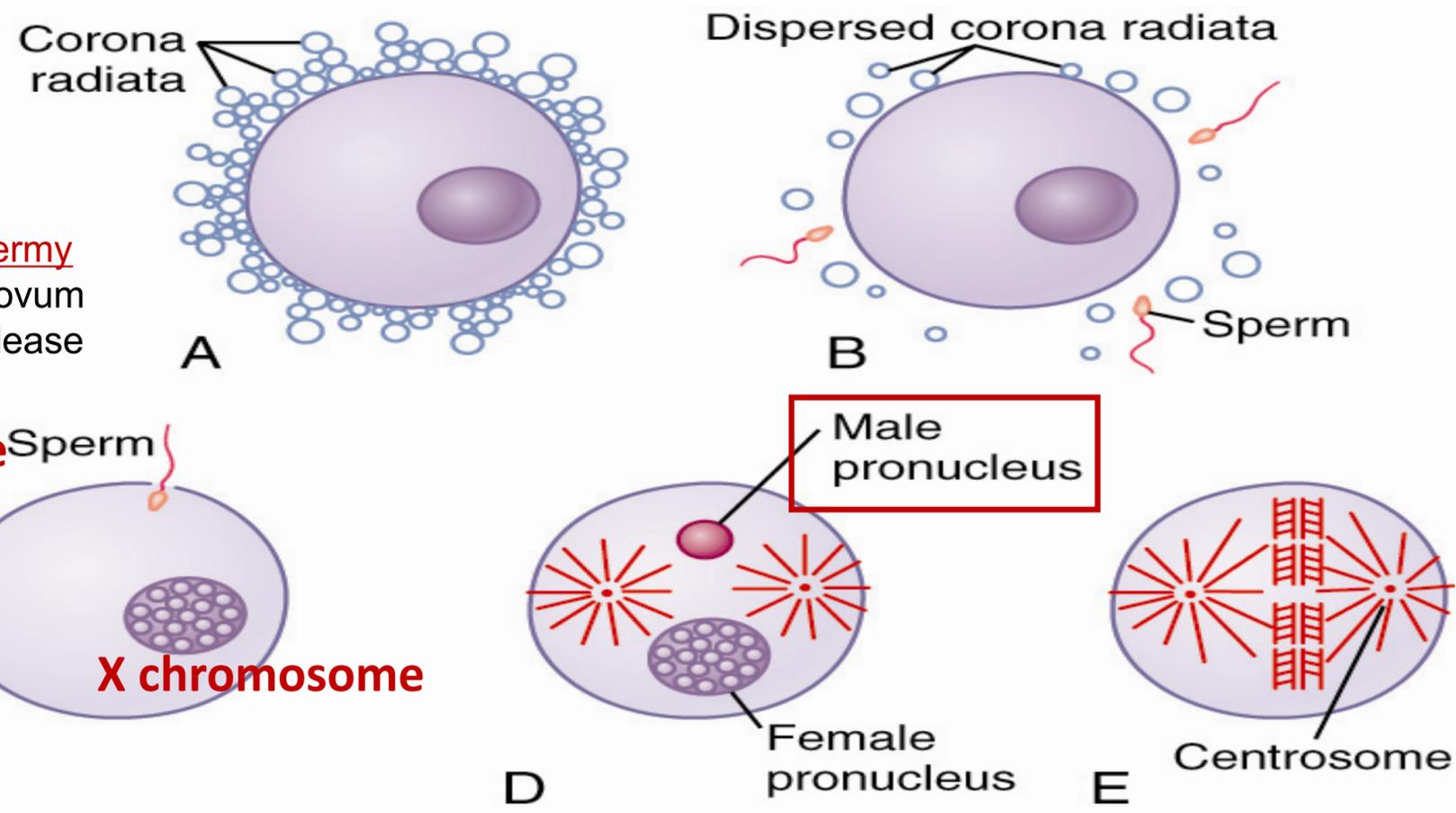
transport of sperm is aided by:

- 1- contractions of the uterus and FT → PG in seminal fluid
- 2- oxytocin during female orgasm

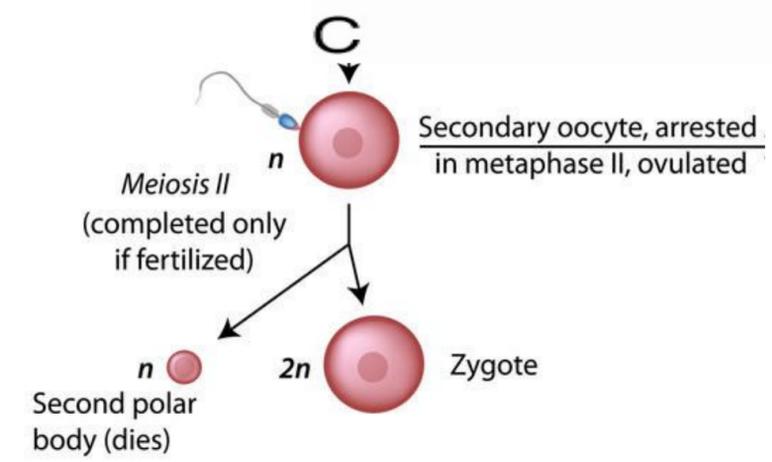
Fertilization

Bind to & penetrate zona pellucida
release acrosomal enzymes, hyaluronidase and proteolytic enzymes

Fusion of 1 sperm prevents polyspermy
↓ in the membrane potential of the ovum
↑ IP3 in ovum → Ca release → release of enzymes → hardening of ZP



X/y chromosome Sperm
X chromosome



23 unpaired chromosomes of male pronucleus + 23 unpaired chromosomes of female pronucleus align themselves → re-form a complete complement of 46 chromosomes (23 pairs) in the fertilized ovum or zygote

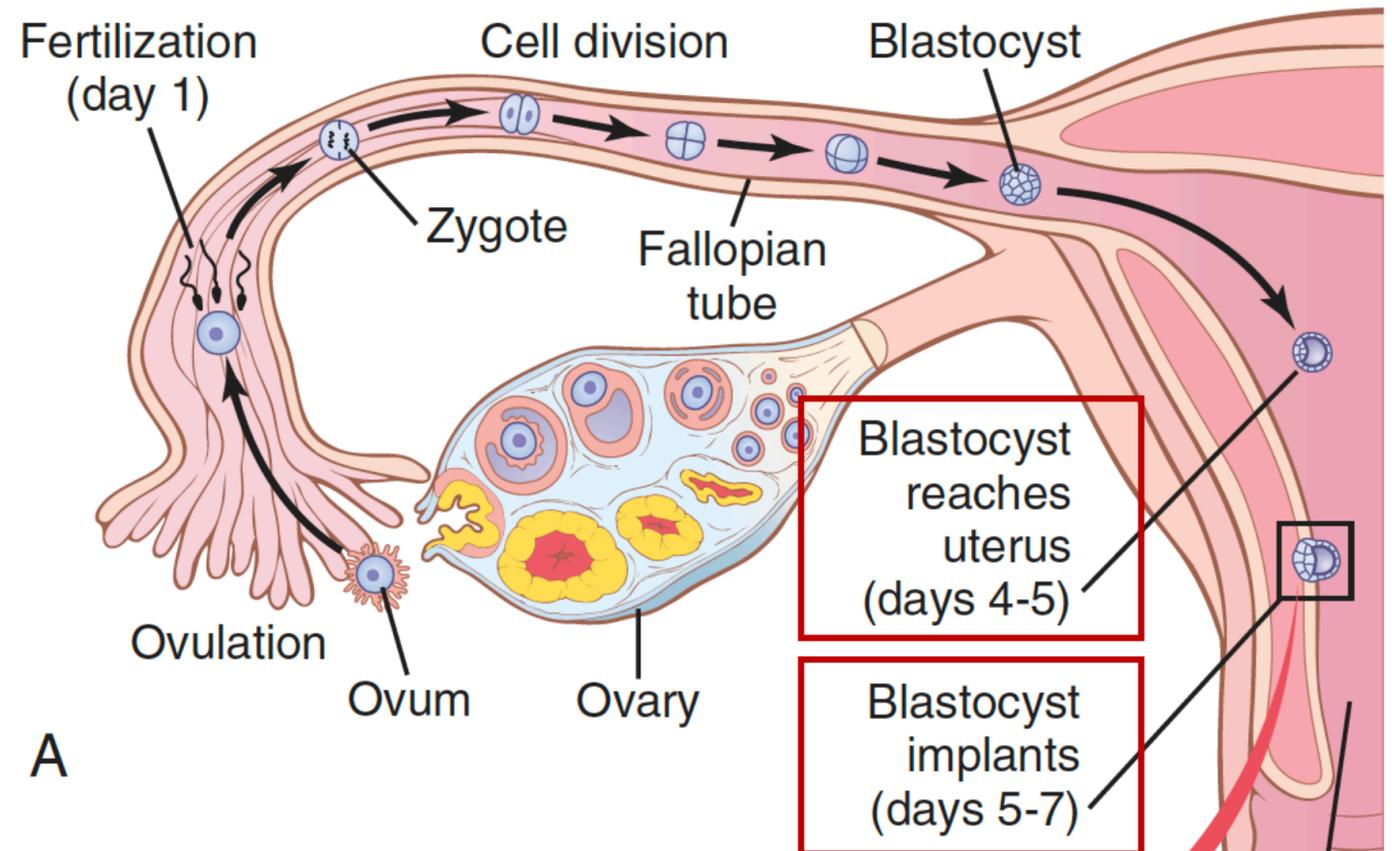
Once a sperm has entered the → the oocyte divides to form mature ovum + second polar body

Transport of fertilized ovum

- 3 - 5 days after fertilization → ovum is transported to U cavity

Aided by:

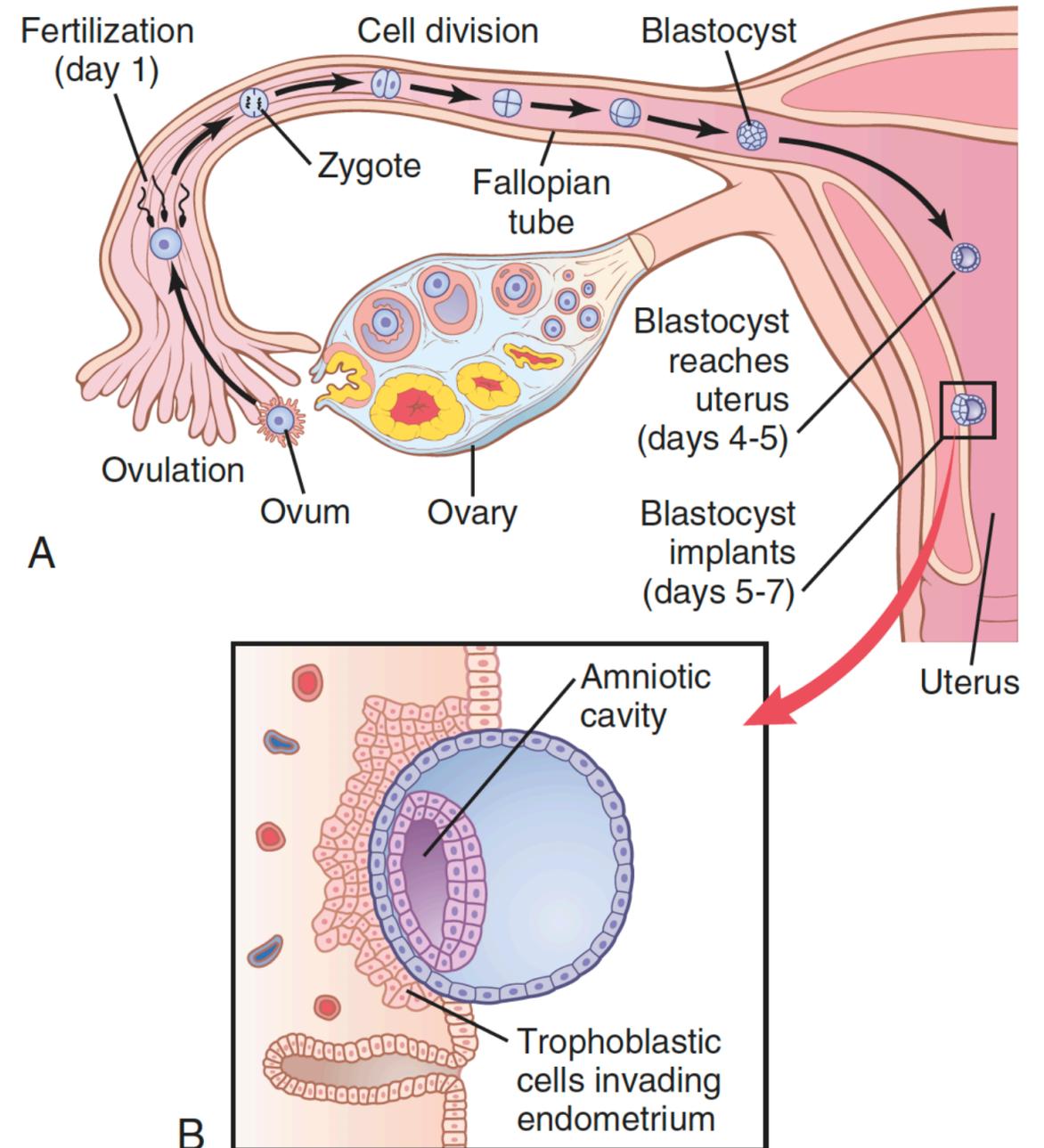
- Epithelial secretions
 - Cilia action
 - Weak contractions of fallopian tube
-
- Several division of the developing embryo take place before implantation (blastomere → morula → blastocyst)



Implantation of fertilized ovum

Mediated by trophoblast on surface of the blastocyst → Proteolytic enzymes

Invasion results in fluid secretion → nutrient trophoblast & blastocyst (foetus) + endometrium (mother) → **placenta**



Nutrition during pregnancy

nutrition

- FT → FT secretions
- Uterine cavity

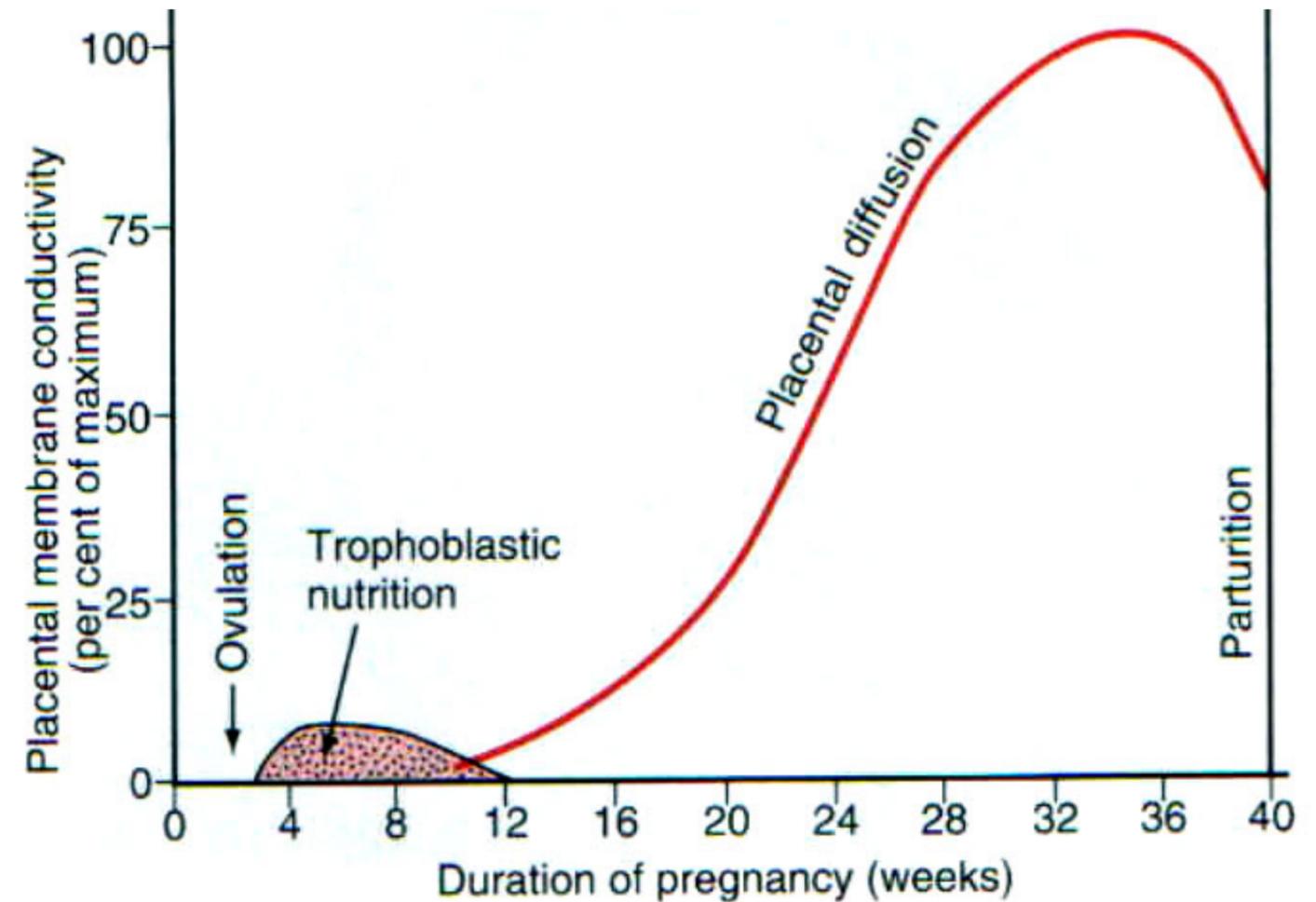
Before imp.

- uterine endometrial secretions “uterine milk”

After imp.

- decidual cells/decidua : glycogen, proteins, lipids & minerals

↖
Progesterone effect



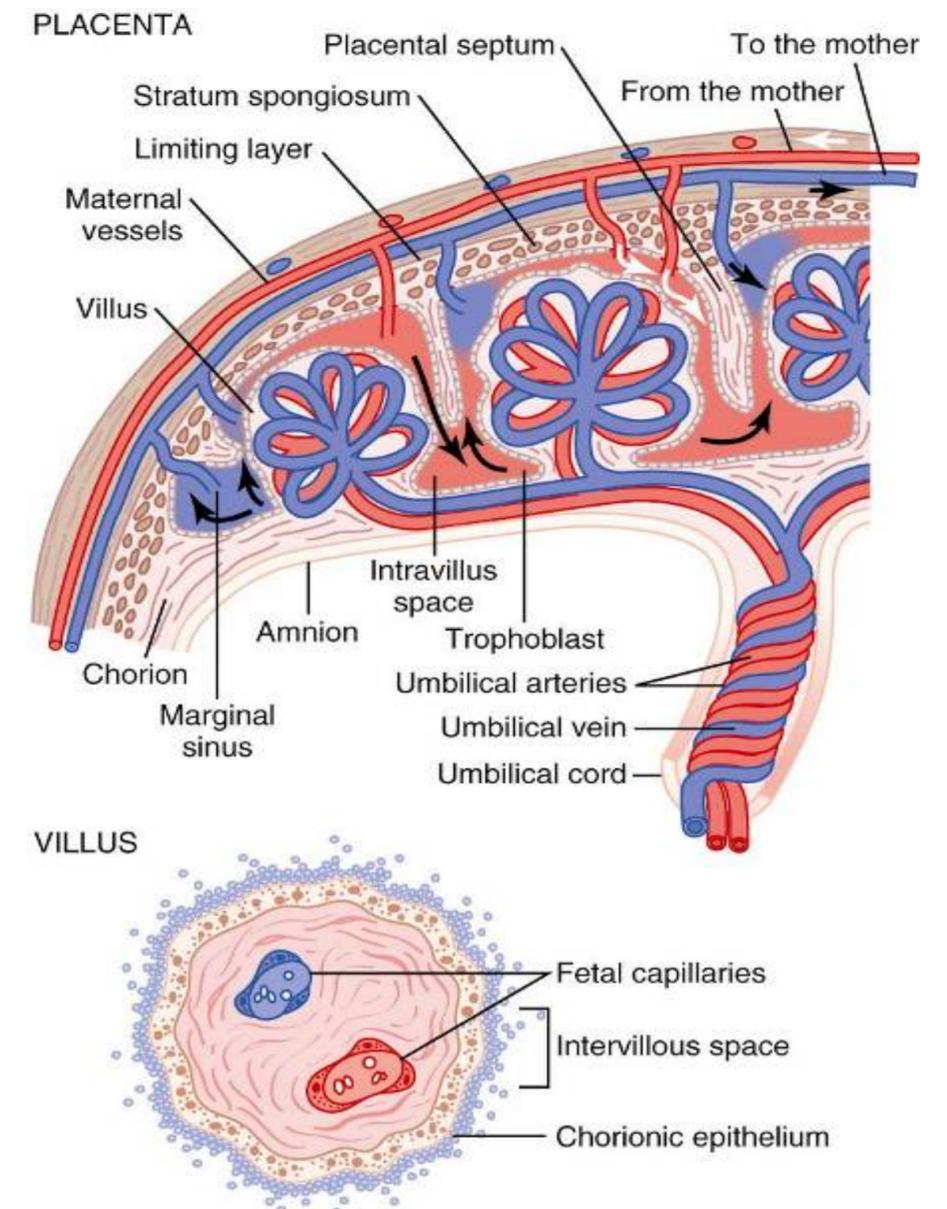
Functions of the placenta

major function:

providing food & oxygen from the mother's blood into the fetus's blood
diffusion of excretory products from the fetus back into the mother

early months of pregnancy → ↓ placental permeability → thick placental membrane & ↓ surface area

later months of pregnancy → ↑ placental permeability → thin placental membrane & ↑ surface area



Circulation of the placenta

2 umbilical arteries + one umbilical vein
connected capillaries called chorionic villi

Exchange between chorionic villi & maternal sinuses of uterine artery

Diffusion of gases through placenta

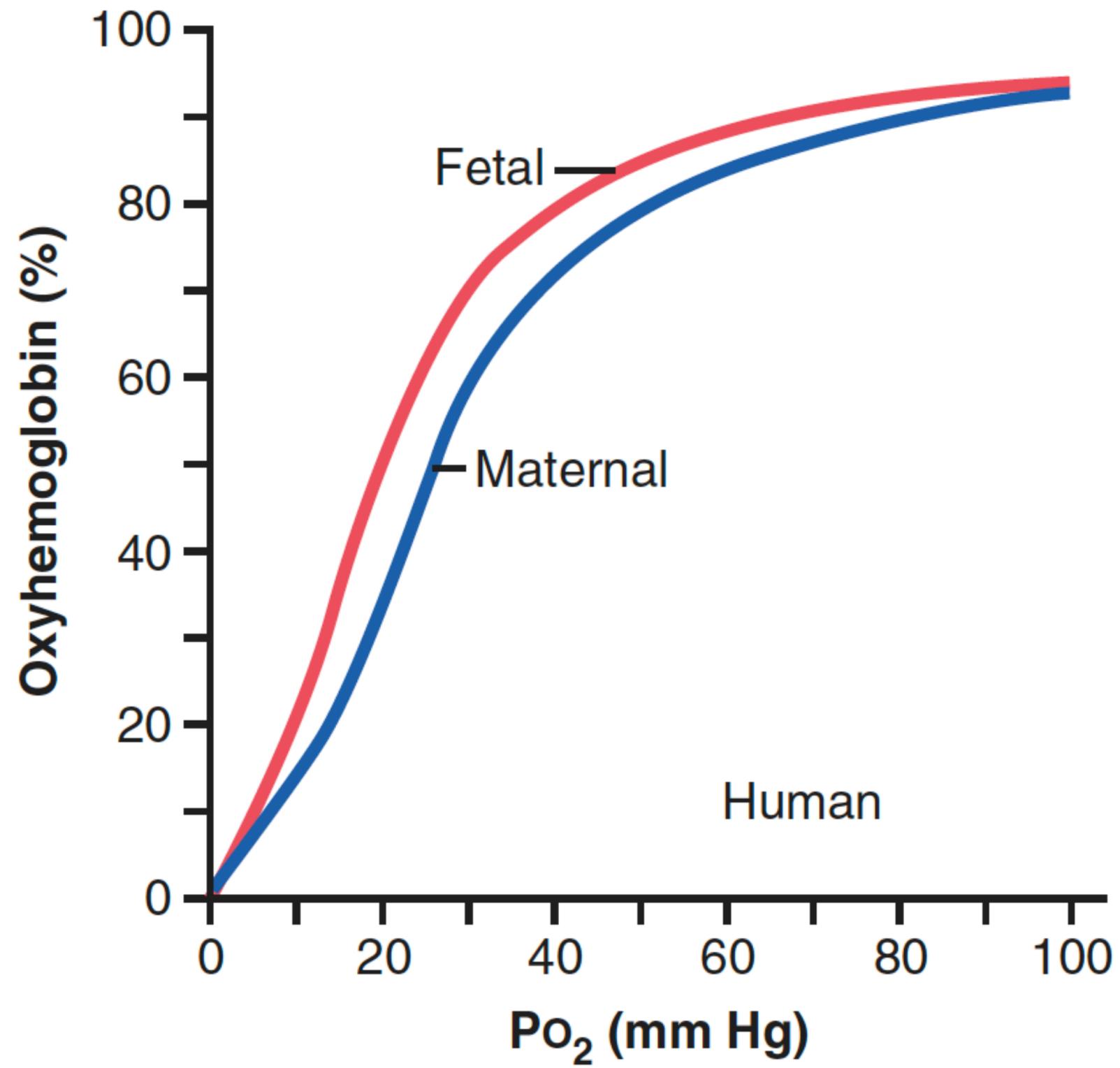
- **Diffusion of oxygen**
- Oxygen is transported by **simple diffusion**
- Maternal PO₂ 50-60 mmHg
- Fetal PO₂ 20-30 mmHg
- **Mean pressure gradient 20 mmHg**

low PO₂ in the foetus capillary

Low oxygen transport!!!
Not the case 😊
Why?

Reasons for enhanced oxygen transport

- 1- fetal haemoglobin has a **higher affinity** for O₂ (20- 50% more oxygen than maternal haemoglobin)
 - 2- 50% greater concentration of haemoglobin in the foetal blood > maternal blood
 - 3- Bohr effect: haemoglobin carry more O₂ at low PCO₂
- CO₂ **diffuses out** from foetal blood → maternal blood → loss of CO₂ makes foetal blood **alkaline** one maternal blood is **acidic** → this **increases the capacity of foetal blood to combine with oxygen & decrees the maternal capacity to combine with oxygen** → more oxygen is delivered to the foetus



Diffusion of gases through placenta

- **Diffusion of CO₂**

Pco₂ fetal blood is 2-3 mmHg >maternal blood → simple diffusion of CO₂

High solubility of CO₂ 20 times > as rapidly as oxygen → enhance CO₂ diffusion

Diffusion of nutrients

Glucose

- Placenta stores glycogen
- by facilitated diffusion (carrier molecules)
- 20 to 30% lower glucose in the fetal blood than maternal blood

Fatty acids

- High solubility
- diffuse slowly

Proteins

- active transport

Minerals

- potassium, sodium and chloride → diffuse easily

Excretion of waste products

- CO₂ → diffusion
- excretory products (urea, uric acid and creatinine)→ diffusion
- [Urea] is just slightly greater in fetal blood →easily diffuse
- [Creatinine] higher in fetal blood → does not diffuse easily

Protective function of the placenta

- Mainly after 3 months
- Impermeable to toxins and bacteria
- Premeable to antitoxins some immunoglobulins, viruses and drugs- malformation

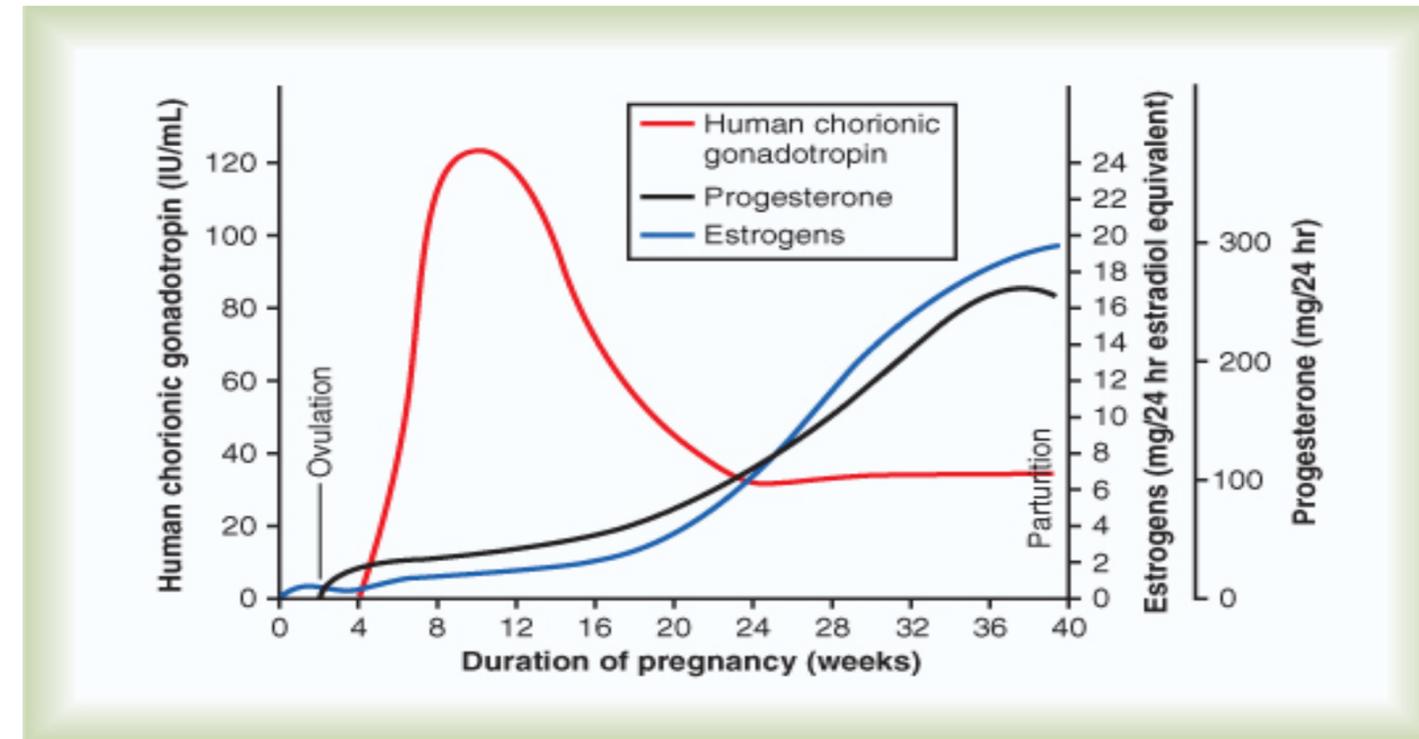
Hormonal functions of the placenta

- Human chorionic gonadotropin
- Estrogen
- Progesterone
- Human chorionic somatomammotropin

Hormonal functions of the placenta

human chorionic gonadotropin (hCG)

- Glycoprotein
- Similar structure and function as luteinizing hormone
- secreted by syncytial trophoblast cells
- detected in the **blood** 8-9 days after ovulation
- maximum secretion 10 -12 weeks of pregnancy
- decreases back to a lower level by 16-20 weeks for the remainder of the pregnancy



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Hormonal functions of the placenta

human chorionic gonadotropin

Functions of human chorionic gonadotropin

- Persistence of the **corpus luteum**

dupplication in CL size → secrete large quantities of progesterone and estrogen →

1-**prevent menstruation** to prevent sloughing of the implanted fetus

2- **Growing of the endometrium & storage of nutrients** →

development of the decidual cells

corpus luteum is very essential for pregnancy

after 12 week →placenta takes the role

involute slowly after the 13th to the 17th week of gestation

Hormonal functions of the placenta

human chorionic gonadotropin

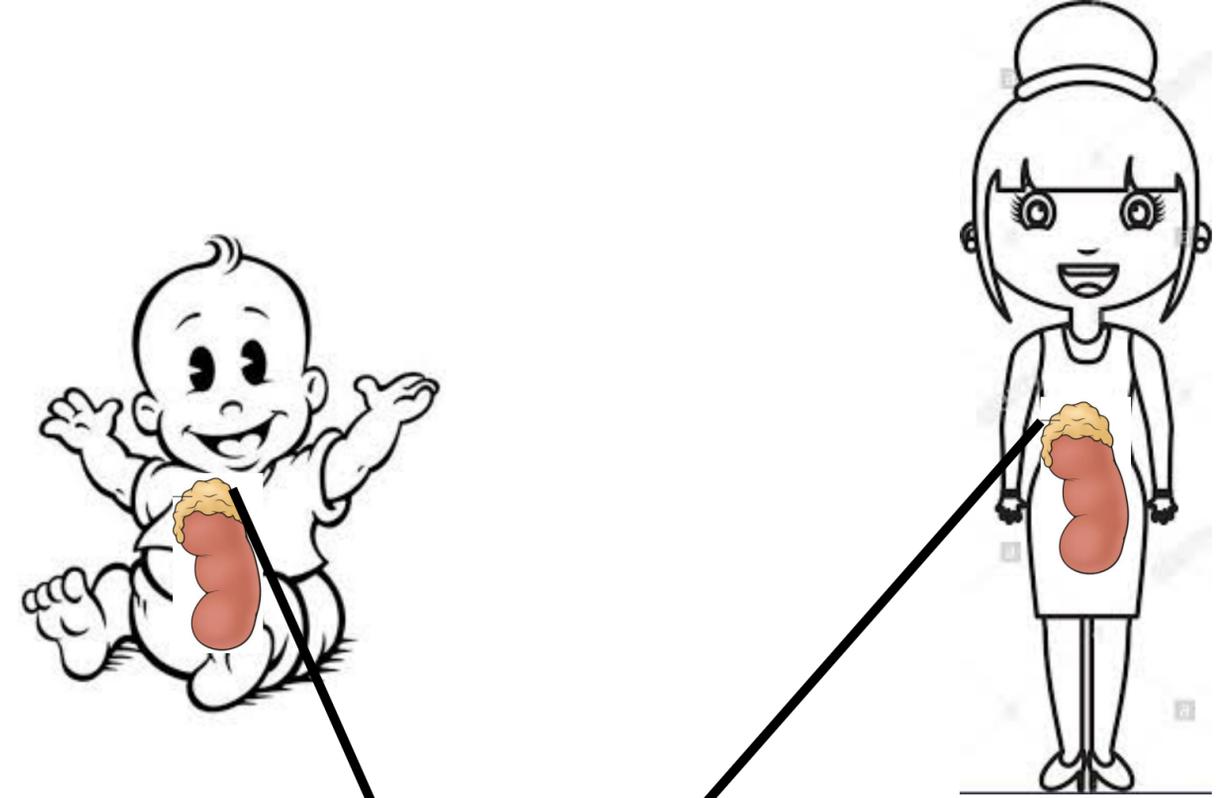
Functions of human chorionic gonadotropin

- Stimulate the male fetal distance to produce **testosterone**
Development of male fetal sexual organs
Descend of the testicles to the scrotum

Hormonal functions of the placenta

Estrogen

- Secreted by the syncytial trophoblast
- Towards the end of pregnancy estrogen production increases up to 30 times

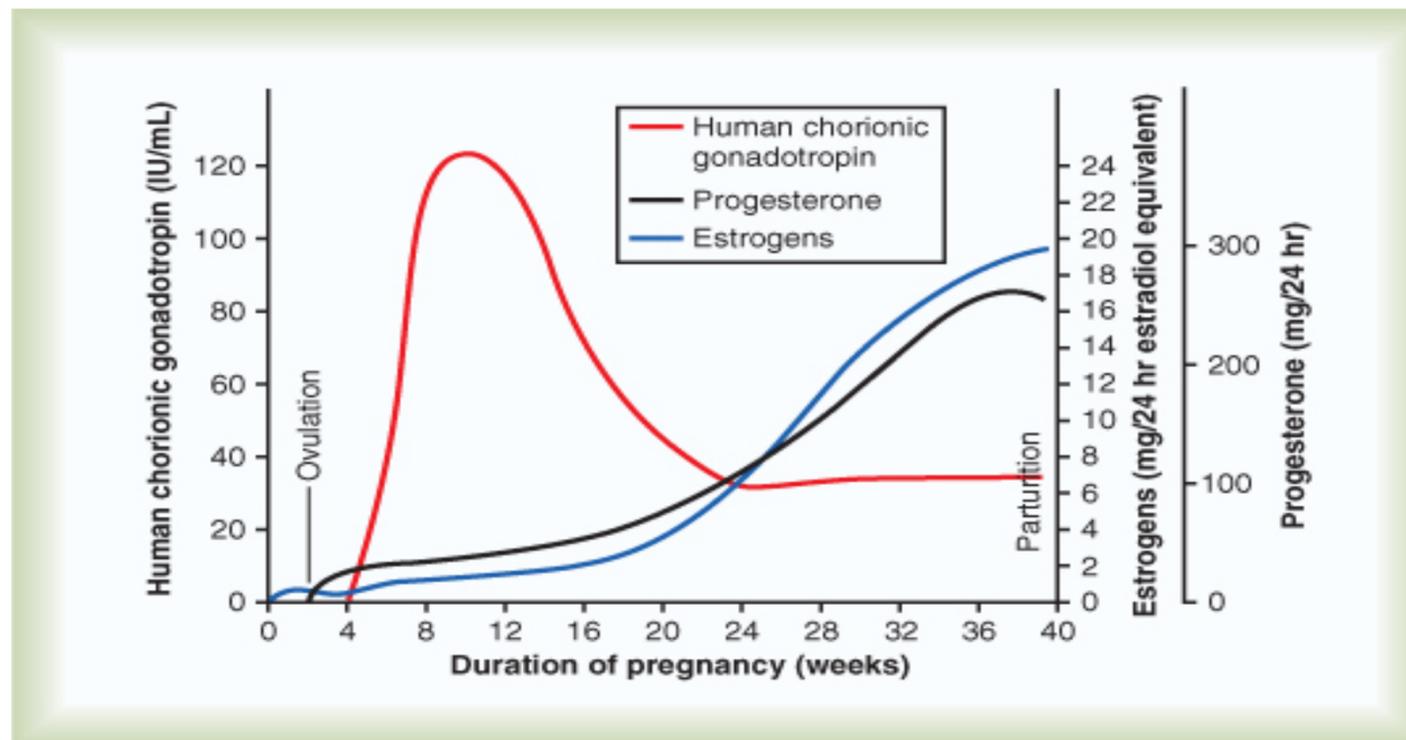


androgenic steroid compounds
 dehydroepiandrosterone
 16-hydroxydehydroepiandrosterone

↓

estradiol, estrone, and estriol.

syncytial trophoblast



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Functions of estrogens

- Enlargement of uterus (myometrium)
- Enlargement of breast and growth of **duct** system of the breast
- Enlargement of female external genital organs
- Relax pelvic ligaments and symphysis pubis of pelvic bone
→ allowing better accommodation for expanding fetus and easy passage through birth canal

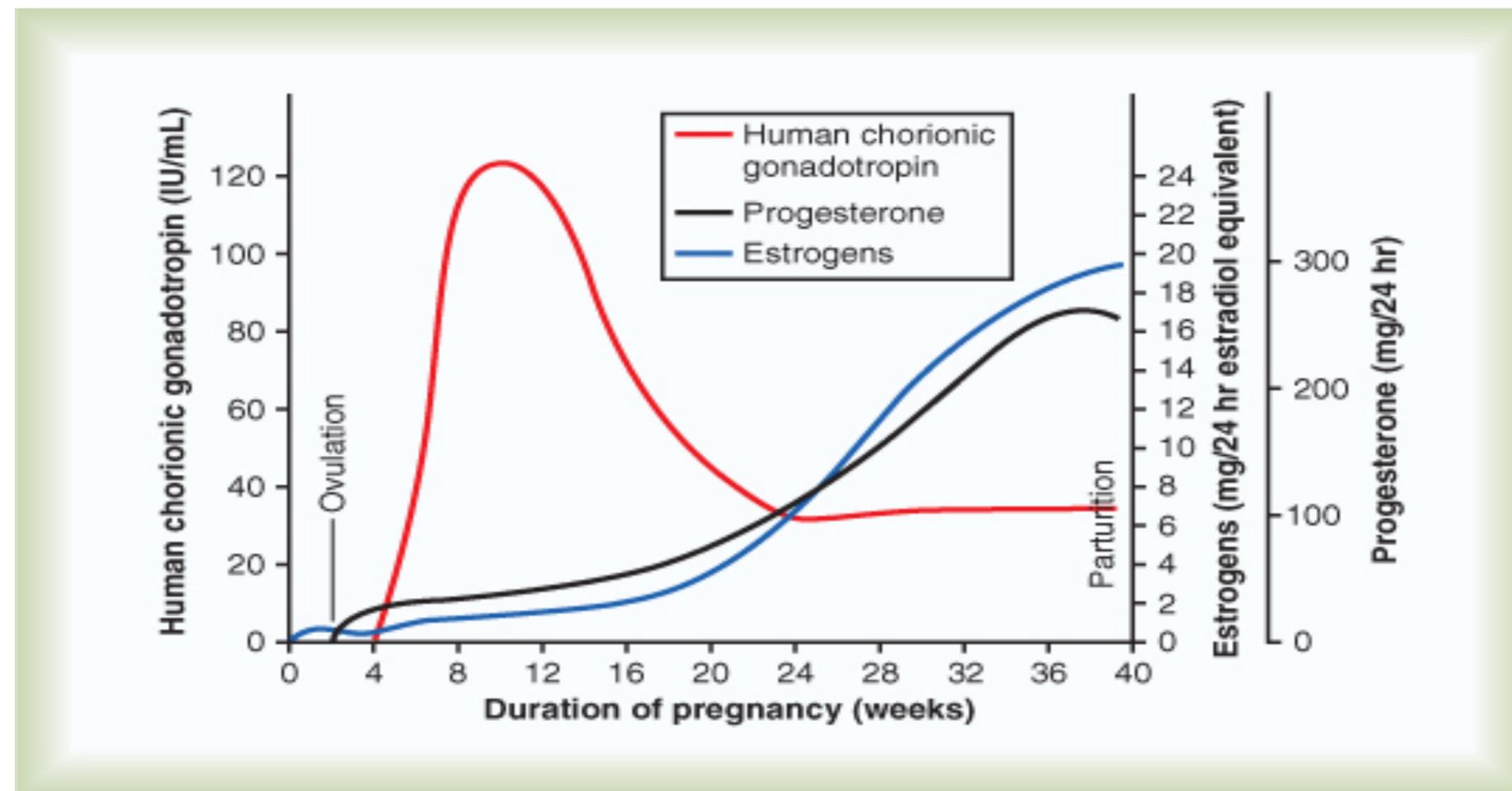
Functions of estrogens

- Increase cholesterol uptake by placenta to augment the synthesis of **progesterone**
- Increase formation of oxytocin receptors
- Both estrogen and progesterone inhibits the action of prolactin on mammary gland , thus no milk synthesis during pregnancy
- fetal development during pregnancy → by affecting the rate of cell reproduction in the early embryo

Hormonal functions of the placenta

Progesterone

- Towards the end of pregnancy, progesterone production increases tremendously



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Hormonal functions of the placenta

Progesterone

Functions of progesterone

- 1- development of decidual cells → nutrition of early embryo
- 2- decreases contractility of the uterus by inhibiting synthesis of PG and by decreasing uterus sensitivity to oxytocin → prevent abortion

Hormonal functions of the placenta

Progesterone

Functions of progesterone

3- development of the conceptus before implantation → increase the secretions of mother FT and uterus → nutrient

4- Affects cleavage of early embryo

5- Development of **alveolar pouches** of mammary glands and increase their capacity to secrete milk

6- Stimulates respiratory centers in mother to increase ventilation

Human chorionic somatomammotropin (HCS)

- Secretion is directly proportional to the weight of placenta
- Can be detected 5 weeks after gestation

Functions

- Has a similar action to **growth hormone** and increases protein synthesis
- development of breasts & causes lactation (similar function to prolactin) → also called human placental lactogen (HPL)

Human chorionic somatomammotropin (HCS)

- antagonize insulin action on carbohydrates increasing maternal blood glucose levels → more glucose available to the fetus
- Stimulates maternal lipolysis → Source of energy for mother

Other hormonal factors in pregnancy

1- increased pituitary secretion

- anterior pituitary enlarge by 50%
- increased corticotropin, thyrotropin & prolactin
- decrease LH and FSH (inhibited by E & P)

2- increase corticosteroid secretions

- moderate increase in glucocorticoids → mobilize amino acids from mother's tissue → used for synthesis of tissues in the fetus
- 2 fold increase in aldosterone → with estrogen → fluid retention by excessive sodium absorption → pregnancy induced hypertension

3- increased insulin

Other hormonal factors in pregnancy

4- increased thyroid gland secretion

- 50% increase in thyroid gland size
- increase thyroxine → stimulated by hCG & human chorionic thyrotropin (secreted by placenta)

5-increased parathyroid gland secretion

- parathyroid gland increase in size
- increase calcium absorption from the mother's bone → used by fetus for bone ossification

6-secretion of relaxin by the ovaries and placenta

- stimulated by hCG
- with estrogen → relaxation of pelvic ligaments
- softening of the cervix at the time of delivery
- vasodilator → increase blood flow increase venous return and cardiac output

The end