

PHYSIOLOGY

Lecture : 12#

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Pregnancy and Lactation-1

Secondary oocyte+ granulosa cell (corona radiata)

↓
Ovulation

↓
Peritoneal cavity

ectopic ovary مش مرتبط بشكل مباشر مع fallopian tubes عشان هيك منقدر نفسر انه في حالات pregnancy ممكن يصير intraabdominal pregnancy لانه ovum ممكن تطلع برا cavity ويصير لها fertilization بعدين

↓
Cilia activation by **estrogen**

↓
Beating toward ostium of FT

وبصير لها beating باتجاه tubes حتى تاخدها من peritoneal cavity

↓
Ova enters fimbriated end of one of FT

Ovum بتطلع على tube يلي بنفس اتجاه ovary يلي طلعت منه وكل شهر تقريبا المبيضين بيتناوبوا تطلع بويضة وحدة منهم من كل جهة يعني شهر بتطلع من اليمين وشهر بتطلع من اليسار

↓
Secondary oocyte at **ampulla of FT** ← sperms
هنا sperms يلي بتدخل على FT بتكون اقل من عدد ejaculated ones

↓
Fertilization

transport of sperm is aided by:

هنا sperms بتدخل على vagina شو العوامل يلي بتساعدها انه تدخل على FT

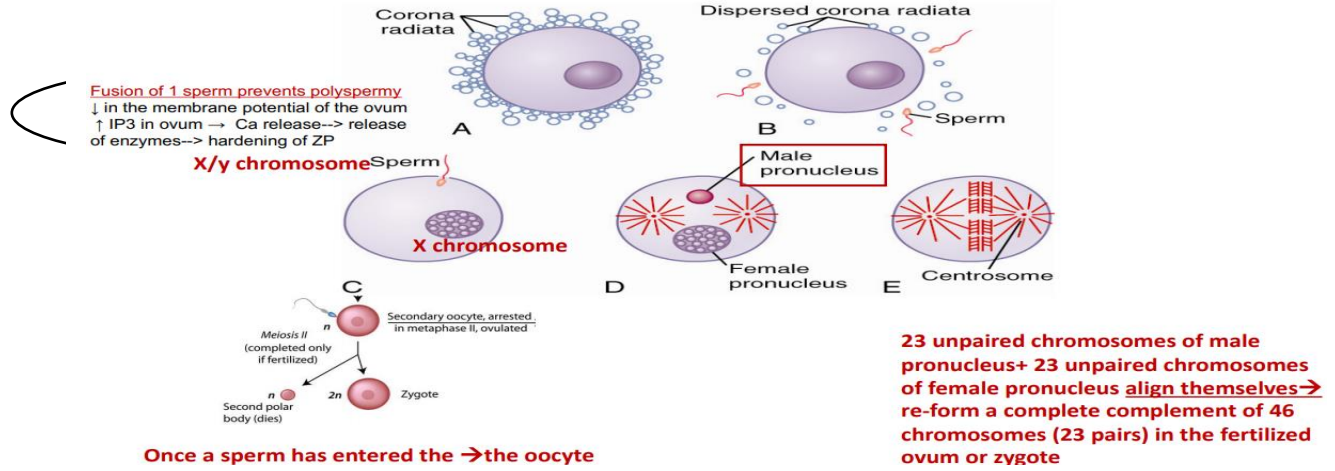
1- **contractions of the uterus and FT** → **PG in seminal fluid**

لانه بتسوي negative pressure وبتساعد على حركة sperms

2- **oxytocin** during female orgasm

Oxytocin helps in contractions

Fertilization



هنا ovum عليها ((multiple of granulosa cells)) corona radiata و sperm قبل ما يسوي fertilization رح يصير dispersing لهاي الطبقة وهلا اول ما تدخل sperm رح يسوي penetrating لل zona pellucida يلي بتحيط ovum وبصير عن طريق acrosomal enzymes inhibition for polyspermy بصير penetration for one sperm وهلا لو صار واحد طيب كيف بتصير عملية inhibition ؟ لانه لما يصير penetration رح يقل membrane potential وبصير increase in IP3 in the ovum وهاد الايشي بسوي stimulation for calcium release وبصير releasing for enzymes بتعمل hardening لل ovum وبالتالي بتمنع sperms انها تدخل..
note :Polyspermy :more than one sperm fertilized the ovum

****ovum عندها x chromosome ولكن sperm اما ان تحمل x chromosome or y chromosome وعشان هيك male هو الذي يحدد fetus gender**

****هلا اول ما تصير ovulation بتكون البويضة 2 arrested in metaphase مجرد ما صار fertilization بصير mature ovum +second polar body وovum بتتركز فيها المادة الوراثية يلي من sperm وبيختفي tail لحتى يصير (fertilized ovum) zygote والمادة الوراثية بتكون من الاب (paternal) ومن الام (maternal) ويصير alignment for the pair of chromosomes وعشان يصير 46 chromosome**

****وبمجرد ما يصير fertilized ovum يصير لها transport من ampulla لحد uterine cavity**

Transport of fertilized ovum

3 - 5 days after fertilization ovum is transported to U cavity Aided by:

• Epithelial secretions

بمسك بال fertilized ovum وبساعد بحركتها باتجاه
uterine cavity

• Cilia action

• Weak contractions of fallopian tube

• Several division of the developing embryo take
place before implantation

عدة انقسامات بتصير قبل
implantation

(blastomere (16-32 cell) → morula → blastocyst ((50-100 cell)) **((blastocyst that implants in the body))**

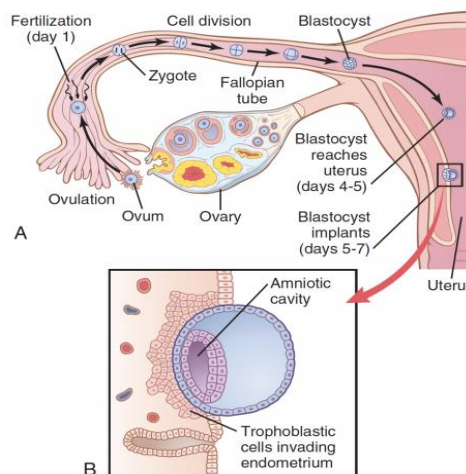
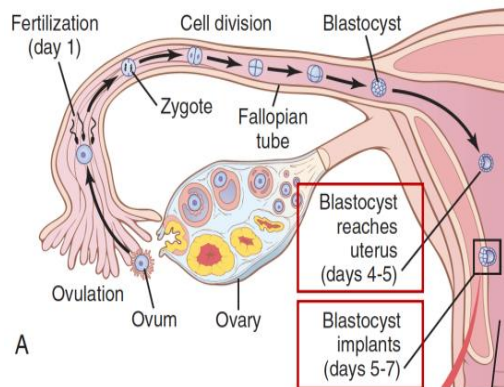
Implantation of fertilized ovum

عشان implantation لازم ovum تخترق جدار
uterus بمساعدة trophoblast

Mediated by trophoblast on surface of the

Blastocyst → Proteolytic enzymes **((in which it degrades the uterine cavity in order to implant the zygote))**

Invasion results in fluid secretion → nutrient
Trophoblast & blastocyst (foetus) + endometrium
(Mother) → Placenta



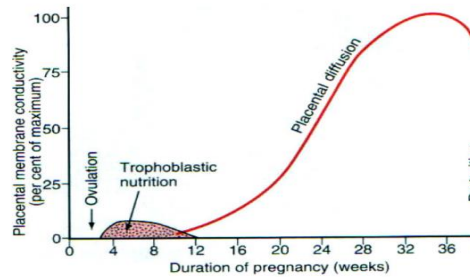
Nutrition during pregnancy

1. FT → FT secretions
2. Uterine cavity :

1-Before imp.

- Uterine endometrial secretions “uterine milk”

By progesterone that secreted in secretory phases ((prepare the endometrial cavity))



2-After imp.

- decidual cells/decidua ((progesterone خلايا المبطنه لجدار الرحم جهازها)) : glycogen, Proteins, lipids & minerals ((for the growth of the fetus))

Progesterone effect

placental diffusion from the mother nutrition عن طريق رح تيجي implantation هلا بعد

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 ((excretion of waste products))

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

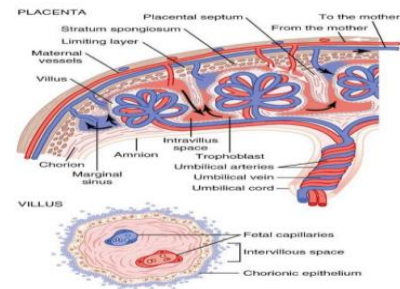
-later months of pregnancy → ↑ placental permeability → thin placental membrane & ↑ surface area

diffusion بصير maternal sinuses(uterine artery) مع exchange of the chorionic villi بصير هلا بصير of nutrients and gases

Circulation of the placenta

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

related to the placenta يعني chorionic اي ايشي



Diffusion of gases through placenta

- **Diffusion of oxygen ((dissolved))**
- Oxygen is transported by simple diffusion
- Maternal PO₂ 50-60 mmHg
- Fetal PO₂ 20-30 mmHg
- Mean pressure gradient **20 mmHg** Reasons for enhanced oxygen transport

الفرق بين maternal PO₂ وبين fetal PO₂

low PO₂ in the foetus capillary

هنا هون منفكر انه نسبة الاكسجين قليلة يلي بتوصل لل fetus ولكن بالعكس نسبة الاكسجين كثير منيحة ول 3 اسباب:

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

معناها بتستقبل اكسجين اكثر

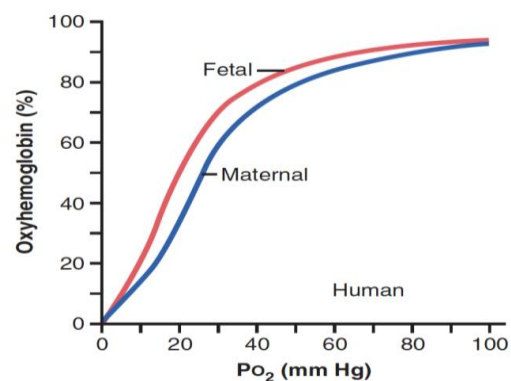
3-Bohr effect: haemoglobin carry more O₂ at low PCO₂

CO₂ is highly diffusible so it can pass to the maternal blood

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 & decres the maternal capacity to combine with oxygen → more oxygen is delivered to the foetus

Fetal hemoglobin is more saturated in oxygen than maternal hemoglobin

وبالتالي fetus بجذب الاكسجين اكثر



• 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 why ?because the baby is metabolically active so it will consume more glucose

Fatty acids

- High solubility
- diffuse slowly

Proteins

- active transport

Minerals

- potassium, sodium and chloride → diffuse easily

Diffusion of nutrients

Excretion of waste products

Placenta بتشتغل زي مبدأ fetus مع kidney

- 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
- وبالتالي creatinine بتراكم اكثر عشان ما صار له diffused

Protective function of the placenta

Mainly after 3 months

عشان هيك منخاف على امهات اول 3 اشهر لانه ما عندهم protective function for the fetus فمنخاف عليهم
من viral infections ,drugs ,etc

- Impermeable to toxins and bacteria
- Permeable to antitoxins some immunoglobulins, viruses (like measles, rubella) and drugs- malformation

Hormonal functions of the placenta

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

Human chorionic gonadotropin(hCG)

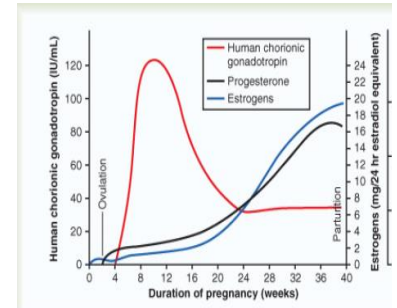
- Glycoprotein
- Similar structure and function as luteinizing hormone

ovulation LH مهم في عملية ovulation وبالتالي HCG منعطي كمحفز لل

- secreted by syncytial trophoblast cells
- detected in the blood 8-9 days after ovulation

ببين عن طريق blood test انه فيه pregnancy

- maximum secretion 10 -12 weeks of pregnancy((it's peak))
 - decreases back to a lower level by 16-20 weeks for the remainder of the pregnancy
- اذا كان عنا نسبة HCG في فترة معينة قليلة رح يدل على انه weak pregnancy leading to abortion



Functions of human chorionic gonadotropin

حتى يكتمل pregnancy لازم يكون في عنا progesterone ومصدرهم لازم يكون منيح

*Persistence of the corpus luteum

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

1-prevent menstruation to prevent sloughing of the implanted fetus

لانه حكينا لو ما في progesterone رح يصير فيه menstruation وبالتالي وجوده رح يمنع menstruation

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

حتى placenta تاخذ الدور في nutrition for the fetus

*Stimulate the male fetal distance to produce testosterone ((if a baby boy))

*Development of male fetal sexual organs

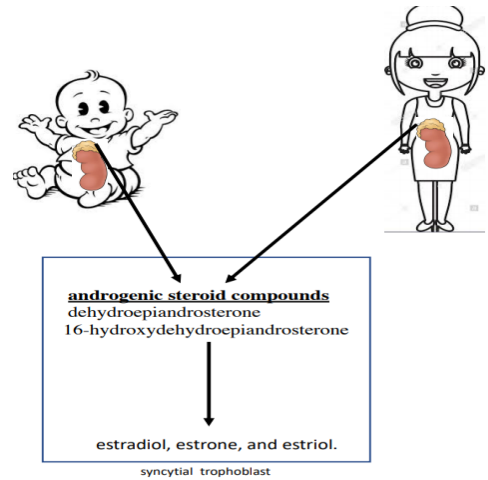
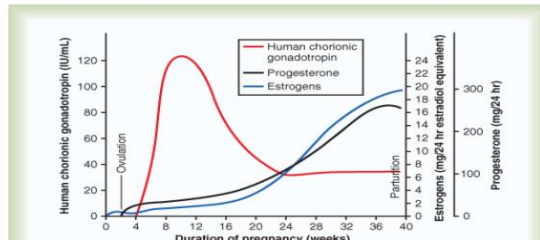
*Descend of the testicles to the scrotum

Estrogen

- Secreted by the syncytial trophoblast

Precursors come from adrenal glands ...

- Towards the end of pregnancy estrogen production increases up to 30 times



estrogen يزيد تدريجيا من اول الحمل حتى يتضاعف لآخر الحمل

Functions of estrogens

- Enlargement of uterus (myometrium)
- Enlargement of breast and growth of duct system of the breast ((for the lactation))
- Enlargement of female external genital organs ((if a baby girl))
- Relax pelvic ligaments and symphysis pubis of pelvic bone → allowing better accommodation for expanding fetus and easy passage through birth canal
- Increase cholesterol uptake by placenta to augment the synthesis of progesterone
- Increase formation of oxytocin receptors

حتى يكبر uterus

Later on to help in labor

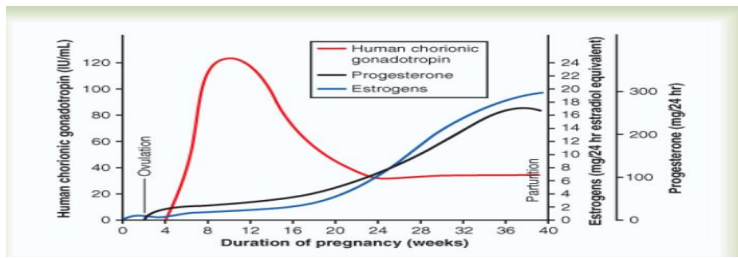
- Both estrogen and progesterone inhibits the action of prolactin on mammary gland, thus no milk synthesis during pregnancy

Progesterone alone can be given to lactating mother for contraception

- fetal development during pregnancy → by affecting the rate of cell reproduction in the early embryo

Progesterone

- Towards the end of pregnancy, progesterone production increases tremendously



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
- 3- Development of the conceptus before implantation → increase the secretions of mother FT and uterus → nutrient
- 4- Affects cleavage of early embryo

Role in cell division of the embryo

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

لا استروجين ولا بروجيسترون الهم علاقة في milk production و الهرمون المسؤول في تصنيع milk هو prolactin

- 6- Stimulates respiratory centres in mother to increase ventilation

عشان بتسحب CO2 من fetus وبتحتاج اكسجين اكثر

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)
- 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

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

dilatation بسوي حتى يساعد في softening of the cervix

- vasodilator → increase blood flow increase venous return and cardiac output

GOOD LUCK 😊