

L12 -Pregnancy

Chapter 83
Unit X1V

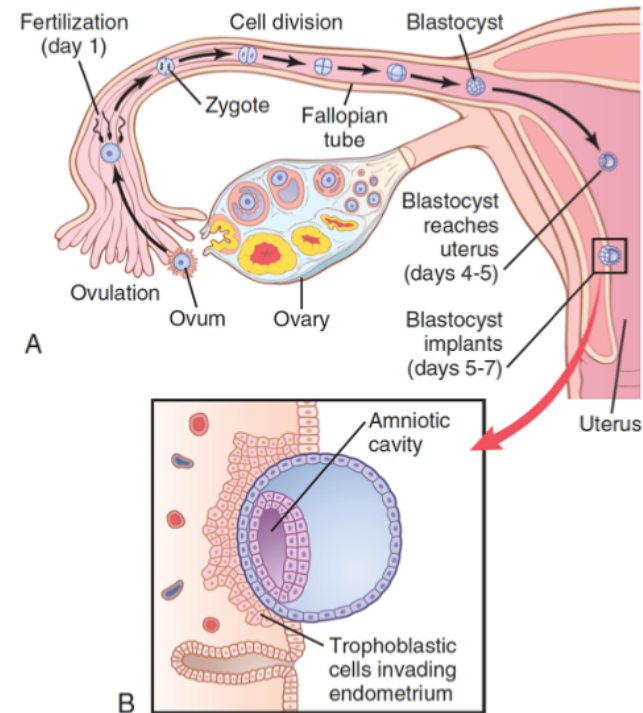
Dr Iman Aolymat

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**



②

طبيب بشو بتفيدنا خطوة ال implantation ؟
 عشان نقدر ناخذ ال nutritional substances اللي جهزها
 هرمون ال progesterone
 كيف ؟ عن طريق ال trophoblasts اللي رح تفرز
 proteolytic enzymes that will dig in the
 endometrial wall and get the nutrients

①

المرة الماضية حكينا انه بصير عنا implantation لل blastocyst بين
 اليوم 5-7

طبيب كيف الموضوع بصير ؟
 ال blastocyst مقسومة جزئين

→ inner set of cells : will become the fetus
 → outer set of cells (trophoblasts) : they bore into the
 endometrium and they will be part of the placenta

Nutrition during pregnancy

Nutrition

- FT → FT secretions
- Uterine cavity

Before imp.

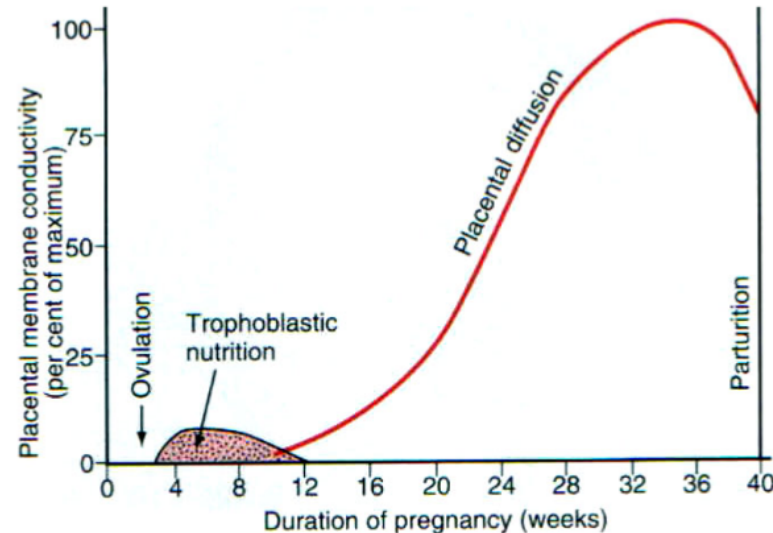
- Uterine endometrial secretions
“uterine milk”

After imp.

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

↑
Progesterone effect

③
الرسمه هاي فكرتها إنه بالبداية ال trophoblasts هي اللي بتكون مسؤولة عن توصيل ال nutritions بعد هيك ال placenta رح تصير هي المسؤولة (بنهاية ال first trimester) و كيف مع الوقت ال placental diffusion بيزيد



①
ال nutrition لل zygote بيحي حسب وين موقعه يعني لما يكون بال fallopian tubes رح ياخذ من ال secretions الموجودة هناك اللي حفز افرازها هرمون ال progesterone و لما يوصل لل uterus في مرحلتين → before & after making the placenta

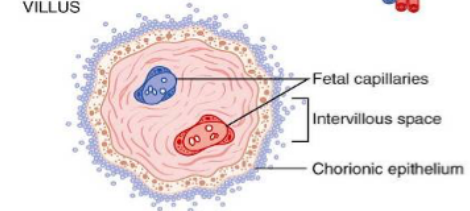
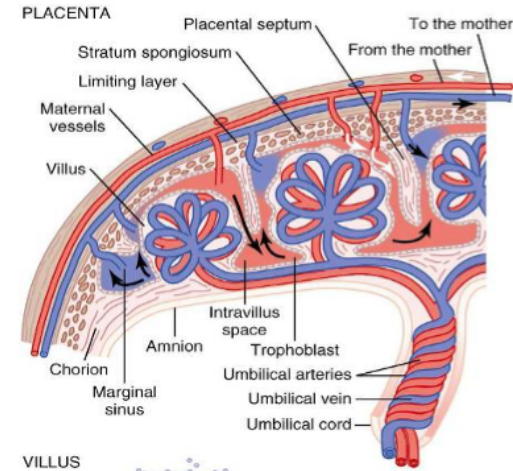
②
مرحلة ما قبل ال placenta مقسومة لجزئين : before and after implantation

- before : uterine secretions
 - After : invasion of the trophoblasts to the decidual cells
- ال decidual cells عبارة عن ال endometrial epithelial cells اللي فيهم المواد اللي بحتاجها fetus ال

Functions of the placenta

2 Major function:

- 1- Providing **food & O₂** from the mother's blood into the fetus's blood
- 2- Diffusion of **excretory products** from the fetus back into the mother



1 **Circulation of the placenta**
 2 umbilical arteries + one umbilical vein ^{from fetus}
 connected capillaries called **chorionic villi**
 fetal capillaries ^{من ال placental tissue} هنا
Exchange between chorionic villi & maternal sinuses of uterine artery

3 ⇒ **Early months** of pregnancy → ↓ placental permeability → **thick** placental membrane & ↓ surface area
 ← مع هيك رح توصل كد ال nutrition اللي بحتاجها ال fetus بجاي المرحلة + الموضوع ال جانبي protective.

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

تطبيق عملي على موضوع ال placenta هو إنه أحيانا ال placenta بتضلها thick وبالتالي there is high resistance within ال placenta the placenta و هاد الاشئ يعمل عند المريضة gestational اللي ممكن يعمل preeclampsia hypertension

← الدكتور ما دخلت بالتفاهيل :-

Diffusion of gases through placenta

oxygen
CO₂

Diffusion of oxygen

- O₂ is transported by **simple diffusion**
- Maternal PO₂ → 50 mmHg
- Fetal PO₂ → 30 mmHg
- Mean pressure gradient 20 mmHg

Concentration gradient → easier Diffusion

Low PO₂ in the foetus capillary

only 30 mmHg !!

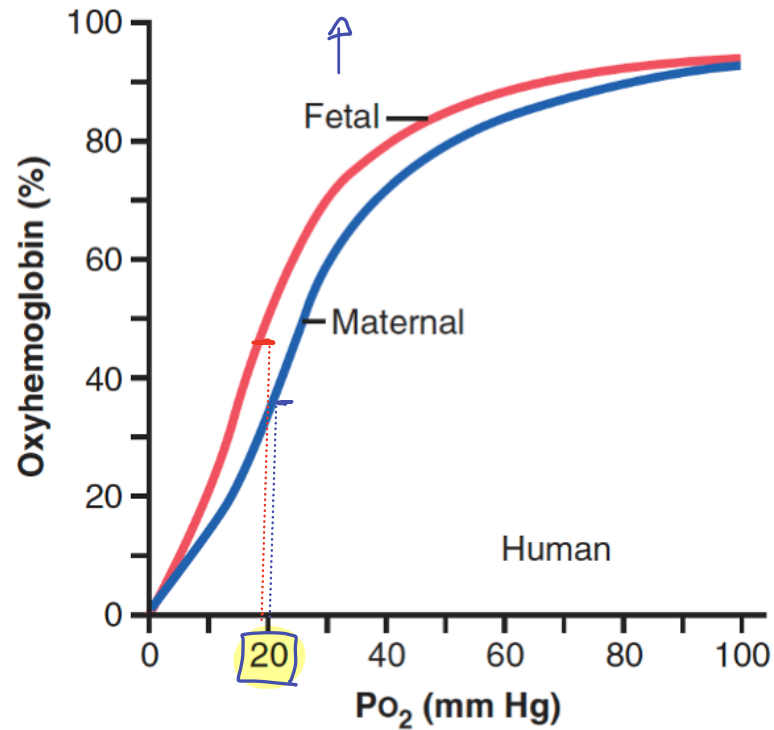
Low O₂ transport!!!
Not the case 😊
Why?

Reasons for enhanced oxygen transport

- Fetal haemoglobin has a **higher affinity** for O₂ (20- 50% more O₂ than maternal haemoglobin)
- 50% greater concentration of **haemoglobin** in the foetal blood > maternal blood
- 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 & decreases the maternal capacity to combine with oxygen** → more oxygen is delivered to the foetus

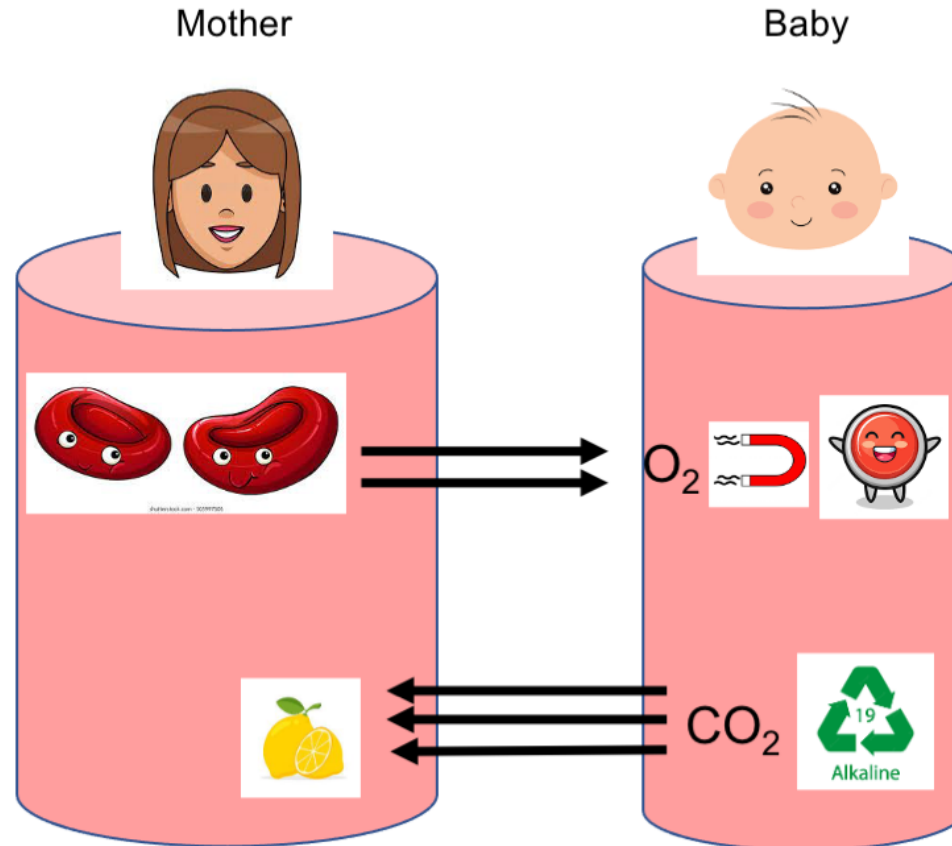
Shifted to the left

⇒ at same concentration of O_2
fetal Hb will be more saturated (Higher affinity)



Oxyhemoglobin dissociation curves for maternal & fetal blood, showing that fetal blood can carry a **greater quantity of oxygen** than can maternal blood for a given blood PO₂.

Bohr effect



On the maternal side, this CO₂ diffusion from the fetal side makes maternal blood in the placenta **more acidic**.

This shifts oxygen curve towards the right and more oxygen is released from maternal Hb.

The umbilical arteries carry de-oxygenated blood with high CO₂ content from the fetus to the placenta.

In the placenta, CO₂ from fetal blood diffuses into maternal blood down its concentration gradient.

As CO₂ content of fetal blood decrease, this makes fetal blood **relatively alkaline** and shift the oxygen dissociation curve toward left, **facilitating more oxygen uptake by fetal Hb**

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	<ul style="list-style-type: none">• Placenta stores glycogen• By facilitated diffusion (carrier molecules)↳ 20-30% lower glucose in the fetal blood than maternal blood ↳ because the fetus is very metabolically active.
Fatty acids	<ul style="list-style-type: none">• High solubility• Diffuse slowly
Proteins	Active transport
Minerals	K, Na & Cl → 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
- Permeable to antitoxins some immunoglobulins → ↑immunity → This will protect the Baby in his first 6 months after Birth.
- Permeable to some viruses and drugs → malformation
↓
as mumps
measles
chicken pox.

Hormonal functions of the placenta

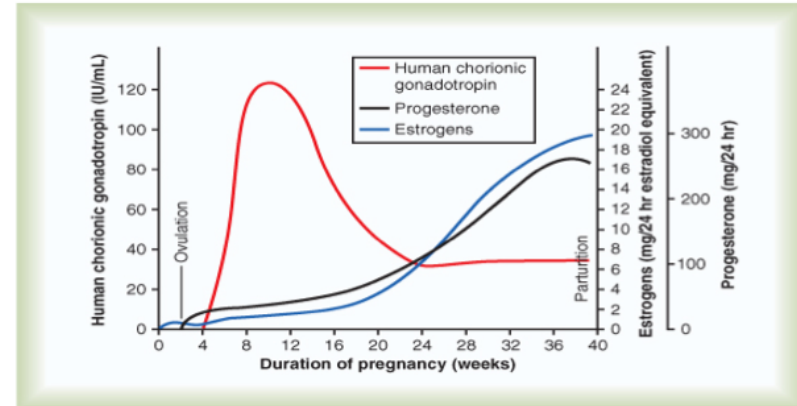
- ① • Human chorionic gonadotropin (hCG)
- ② • Estrogen
- ③ • Progesterone
- ④ • Human chorionic somatomammotropin

* chorionic → related to placenta

Hormonal functions of the placenta

human chorionic gonadotropin (hCG)

- Glycoprotein
- Similar structure and function as **LH**
- secreted by **syncytial trophoblast cells**
- *important* detected in the **blood** 8-9 days after ovulation (earlier Detection → Before missing the cycle)
- maximum secretion 10 -12 weeks of pregnancy & decreases later on.



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→ in contrast to **urine** detection which may take 2 weeks to give a positive HCG test.

Hormonal functions of the placenta

human chorionic gonadotropin

Functions of human chorionic gonadotropin

- ① • Persistence of the corpus luteum → 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) (decidualization by HCG Hormone)

corpus luteum is very essential for pregnancy

after 12 week → placenta takes the role, CL involute slowly after that.

Hormonal functions of the placenta

human chorionic gonadotropin

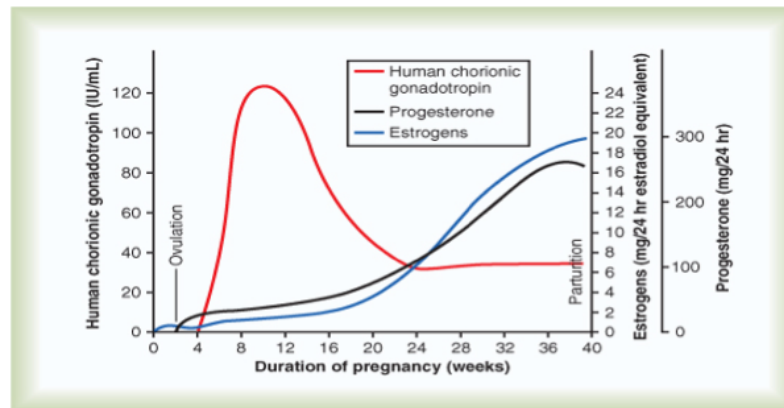
Functions of human chorionic gonadotropin

- ② • Stimulate the male fetal testes 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



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Functions of estrogens

- ① • Enlargement of uterus (myometrium) → *muscles of the uterus.*
- ② • Enlargement of breast and growth of **duct** system of the breast
*الـ Breast ما بصير له full maturation إلا بعد أول pregnancy .**
- ③ • Enlargement of female external genital organs
- ④ • **Relax pelvic ligaments and symphysis pubis** of pelvic bone
→ allowing better accommodation for expanding fetus and easy passage through birth canal

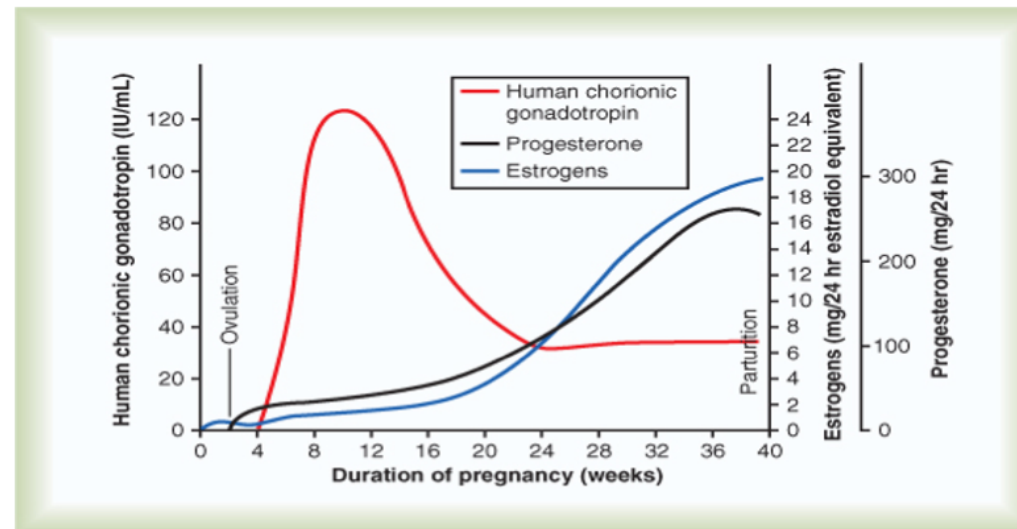
Functions of estrogens

- ⑤ • Increase cholesterol uptake by placenta to augment the synthesis of progesterone
- ⑥ • *→ important.* Increase formation of **oxytocin receptors** *عشان وقت الولادة لما يقل ال progesterone ، يكون عندي oxytocin receptors ويعمل uterine contraction*
- ⑥ • *→ very important* Both estrogen and progesterone **inhibits** the action of **prolactin** on mammary gland , thus **no milk synthesis during pregnancy**
- ⑦ • 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: *→ important.*

• ↓ **synthesis of PG**

• ↓ **uterus sensitivity to oxytocin** →



prevent abortion

زي ما حكينا قبل شوي ، الاستروجين رح يزيد عدد ال receptors لل oxytocin لكن خلال الحمل و البروجسترون العالي ما رح يقدر ال oxytocin يشتغل و يعمل انقباضات لأنه البروجيسترون بثبطه

Hormonal functions of the placenta

Progesterone

Functions of progesterone

- 3- Increase the secretions of mother FT and uterus → nutrient → development of the conceptus before implantation
fetus.
- 4- Development of **alveolar pouches** of mammary glands and increase their capacity to secrete milk
- 5- Stimulates **respiratory centers** in mother to increase ventilation
*(Hyperventilation), why? ↑ demand of O₂ ← mother
Baby.*

Human chorionic somatomammotropin (HCS)

Functions

- ① • Has a similar action to growth hormone and increases protein synthesis
- ② • Development of breasts & causes lactation (similar function to prolactin)
→ also called human placental lactogen (HPL)

Human chorionic somatomammotropin (HCS)

- ③ • **Antagonize insulin** action on carbohydrates increasing maternal blood glucose levels → more glucose available to the fetus
- ④ • Stimulates maternal **lipolysis** → Source of energy for mother

→ in normal pregnancy, the level of glucose in circulation is increased.

→ by default → ↑ insulin → ↑ glucose uptake → less glucose available for the baby.
but this isn't the case

⇒ HCS will antagonize insulin ⇒ ↑ glucose in maternal circulation
⇒ enough glucose diffused to the baby = Happy baby ☺

Other hormonal factors in pregnancy

Pituitary	<ul style="list-style-type: none"> • Enlarge by <u>50%</u> • Increased <u>corticotropin</u>, <u>thyrotropin</u> & <u>prolactin</u> → P will inhibit Lactation • Decrease <u>LH</u> and <u>FSH</u> (<u>inhibited</u> by <u>E</u> & <u>P</u>) ← بزرگ ترکیز ال پرولاکتین بسبب ما بھیر عندی Lactation. <p style="text-align: right; color: red;">During Pregnancy High F8</p>
Adrenals	<ul style="list-style-type: none"> • ↑ <u>glucocorticoids</u> → <u>mobilize amino acids</u> from mother's tissue → used for tissue synthesis in fetus • ↑ <u>aldosterone</u> → with estrogen → <u>fluid retention</u> by excessive Na absorption → ?pregnancy induced hypertension
Pancreas	<ul style="list-style-type: none"> • ↑ <u>insulin</u>
Thyroid	<ul style="list-style-type: none"> • Enlarge by <u>50%</u> • <u>thyroxine</u> → <u>stimulated by hCG & human chorionic thyrotropin</u> (secreted by placenta)
Parathyroid	<ul style="list-style-type: none"> • ↑ <u>PTH</u> → <u>↑Ca absorption</u> from mother's bone → <u>fetus bone ossification</u>

The end