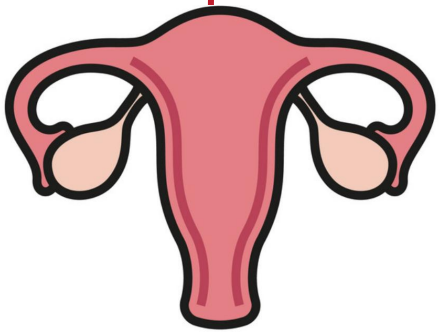

Fertilization and Implantation

Reproductive block-Embryology-Lecture 5

Editing file

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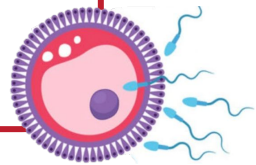


Color index:

- Girls' slides
- Boys' slides
- Main content
- Extra
- Important
- Drs' notes

Objectives

At the end of the lecture, students should be able to:

- Identify fertilization and its site.
- List the phases of fertilization.
- Describe the results of fertilization.
- Describe the formation of blastocyst.
- Identify implantation and its site.
- Describe the mechanism of implantation.
- List the common sites of ectopic pregnancies.

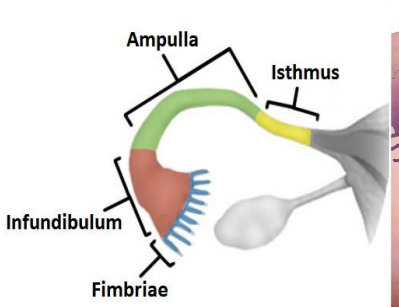
Important notes by Females' doctor:

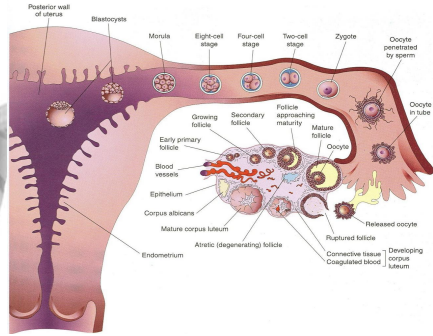
المسميات مهمة وفرقوا بين الأيام

Implantation مهمة وشكل الجنين وقتها وايش اسمه بالضبط

Fertilization وين يكون بالضبط والـ **Most type** واعرفوا انه ممكن يصير بأي مكان بالـ**Tube**

Fertilization

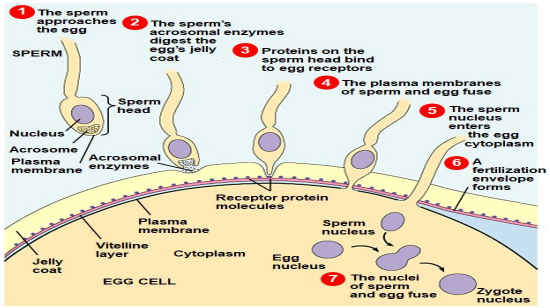




- It is the process during which a male gamete (sperm), and a female gamete (oocyte) (with haploid numbers of chromosomes = 23 each), unite together to form a single cell (ZYGOTE) (with diploid number of chromosomes =46) .
- It is a complex process, begins with a contact between sperm & ovum.
- Ends up with intermingling of the maternal and paternal chromosomes

Location of Fertilization

- It usually occurs in the ampulla of uterine tube, which is the widest part of the tube.
- Also may occur in any other part of the tube, but Never occurs in the uterine cavity.
- Chemical signal from oocyte attracts the sperms.
- Also peristaltic movement of the tube from medial to lateral help the sperm to reach the oocyte
- Before fertilization , the sperm undergoes "capacitation" which is a period of conditioning (around 7 hours) that occurs the female reproductive tract during which in the perforation of walls of the oocyte.



Phase of Fertilization

1 **Passage** of the sperm through the cells of the **corona radiata** by the effect of:
1. Hyaluronidase enzyme secreted from the sperms.
2. By movement of its tail.

2 **Penetration** of the zona pellucida في الحقيقة انها منطقة شفافة by acrosine (acrosomal enzymes) (a substance secreted from acrosomal cap) رأس الحيوان المنوي

3 **Fusion** of the plasma membranes of the oocyte and the sperm. يدخل داخل البويضة المادة الوراثية للحيوان المنوي

4 **Completion** of the second meiotic division of the oocyte بعد دخول المادة الوراثية للحيوان المنوي داخل البويضة, which was arrested at (metaphase) to become mature ovum

5 Formation of the female pronucleus the nucleus of the ovum becomes the female pronucleus.

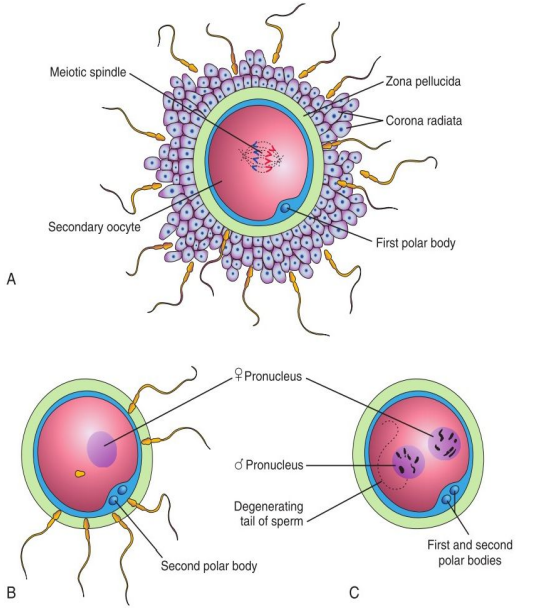
6 Formation of the male pronucleus. the nucleus in the head of sperm enlarges to formthe male pronucleus & the tail disappears.

7 Union of the 2 pronuclei to form the zygote
Fusion of both male & female pronuclei to form the zygote.

Fertilization cont.

The Zygote

- Is genetically a unique structure.
- Half of its chromosomes comes from the father and the other half comes from the mother.
- New combination is formed which is different from either of the parents, This mechanism forms **biparental inheritance** and leads to variation of the human species.
- Embryo's chromosomal sex is determined **at the time of fertilization** by the type of sperm (X or Y) that fertilizes the oocyte. So, it is the father whose gamete decides the sex.
- when the lucky sperm enter, a reaction called **Zonal reaction** happen which is a **change in properties** of **zona pellucida** that makes it **impermeable** to other sperms
- Why only one sperm passes through plasma membrane of oocyte? Because of the ZONA REACTION



Results of Fertilization

1. It stimulates the penetrated oocyte to complete its 2nd meiotic division.
2. Restores the diploid number of chromosomes (46) in the zygote.
3. Determines the sex of the embryo, Variation in the features of human species because of the mixing of maternal & paternal chromosomes.
4. Initiates cleavage of the zygote (cell division).

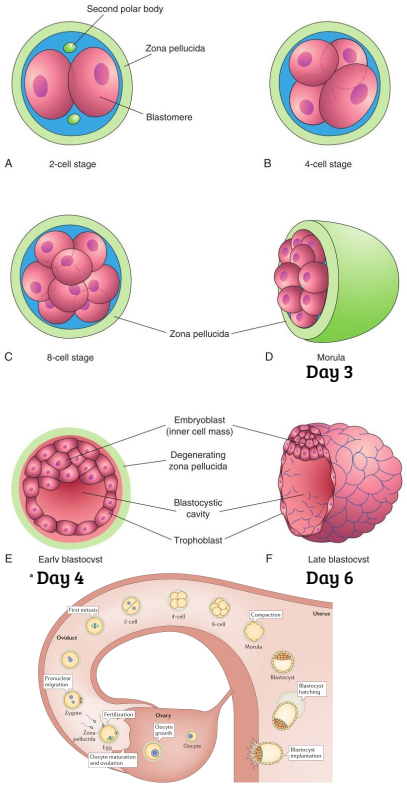
Fertilization cont.

Females' doctor: المسميات مهمة وفرقوا بين الأيام

Only in females' slides

01 Cleavage of Zygote

- It is the repeated mitotic divisions of the zygote.
- Normally occurs in the **uterine tube**.
- Rapid increase in the number of the cells.
- These smaller embryonic cells are now called, Blastomeres.
- Cleavage begins about 30 hours after fertilization.
- Zygote divides into 2, then 4, then 8, then 16 cells and lies within the thick zona pellucida during cleavage.
- Zygote migrates in the uterine tube during cleavage from its lateral end to its medial end to the uterus
- The zona pellucida is a thick translucent membrane under the microscope.



02 Morula

- When there are 16 to 32 blastomeres the developing human is called MORULA.
- Spherical Morula is formed about the 3rd day after fertilization.
- It resembles mulberry or blackberry.
- It reaches the uterine cavity by the 4th day.
- A cavity appears within the morula dividing its cells into 2 groups now its called blastocyst
- Role of Zona pellucida in this stage to help keeping the blastomeres together and prevent sticky blastomeres to adhere to uterine tube.

03 Blastocyst

A cavity appears within the morula dividing its cells into 2 groups:

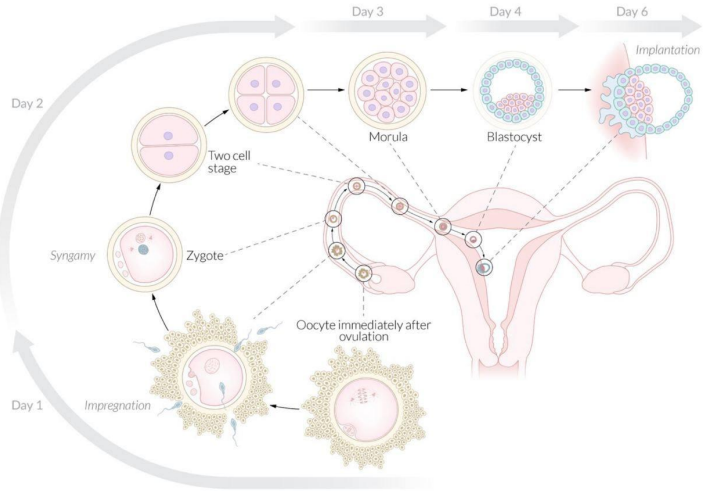
- Outer cell layer called trophoblast. (Forms fetal membranes)
- Inner cell layer (mass) called Embryoblast (forms embryo) attached to one of the poles of the blastocyst.

The cavity is called **blastocystis** cavity or **blastocele**.

Implantation

Definition

It is the process by which the Blastocyst penetrates the superficial (compact) layer of the endometrium (mucous membrane) of uterus
(in which stage implantation happen ? Blastocyst)



Site

The upper part of posterior wall of the body of the uterus near the fundus.

Time

It begins about the 6th day after fertilization and completed by the (10th) 11th or 12th day

Detection of Implantation

Only in females' slides

Can be detected by:

1. Ultrasonography
2. hCG (human chorionic gonadotropin which is secreted by the Syncytiotrophoblast) about the end of 2nd week.
   (detected in the urine, used as a pregnancy test)
3. Early Pregnancy Factor
   - is an immunosuppressant protein secreted by trophoblast cells
   - Appears in maternal serum within 24--48 hrs,after implantation.
   - It is the basis for EPT (Early pregnancy test) in the first 10 days of development.

Implantation: Mechanism

لمن اسألك مين كون لي الـ Uteroplacental circulation؟

Trophoblast divide into cytotrophoblast and syncytiotrophoblast —> this part will invade the endometrium and form lacunae that nutrients and blood drain to it for the embryo

By 4th day

- The Morula reaches the uterine cavity
- It **remains free** within the uterine cavity for one or two days.
- Fluid passes from uterine cavity to the Morula.
- Now the Morula is **transformed into Blastocyst**, its cavity is called blastocystic cavity or blastocele, and its cells divided into Embryoblast & Trophoblast.

By 5th day

- the **zona pellucida degenerates** & disappears to allows the blastocyst to increase in size and **penetrates the endometrium**
- The embryoblast projects into the blastocystic cavity, while the trophoblast forms the wall of the blastocyst

By 6th day

blastocyst **adheres** to the endometrium

By 7th day

Trophoblast differentiated into 2 layers:

1. Syncytiotrophoblast (outer multinucleated cytoplasmic mass, with **indistinct cell boundary**)
2. Cytotrophoblast (inner layer, mitotically active)

By 8th day

syncytiotrophoblast erodes Endometrium & blastocyst is superficially **embedded** in the compact layer of the endometrium

By 9th and 10th 10th or 11th day.

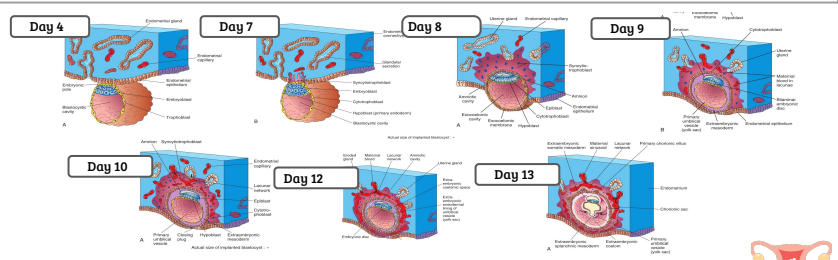
Blood-filled Lacunae appear within the Syncytiotrophoblast which communicate with each other forming a network. The blastocyst is completely appear in syncytiotrophoblast embedded in the endometrium. The defect is filled by a closing plug.

By 11th or 12th day.

- Syncytiotrophoblast erodes the endothelial lining of the maternal capillaries which known as sinusoids
- Now blood of maternal capillaries reaches the lacunae **so Uteroplacental circulation begins**
- Endometrial cells undergo a process called apoptosis (programmed cell death) to facilitates **invasion of endometrium by the Syncytiotrophoblast.**
- Syncytiotrophoblast engulf these degenerated cells for nutrition of the embryo

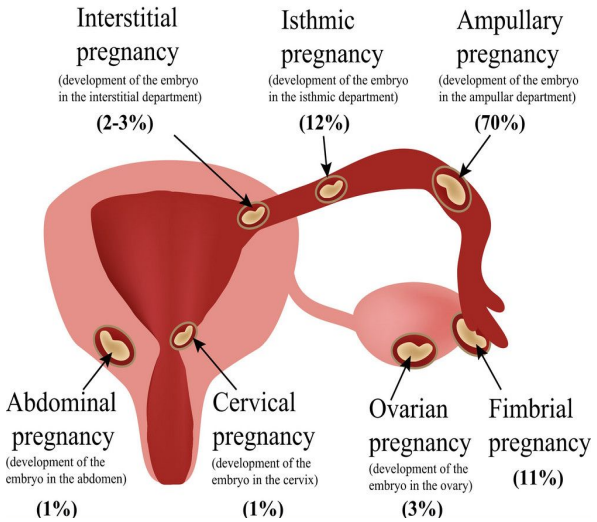
By 13th day

Proliferation of Cytotrophoblast cells produce extension within the Syncytiotrophoblast to form **primary chorionic villi**



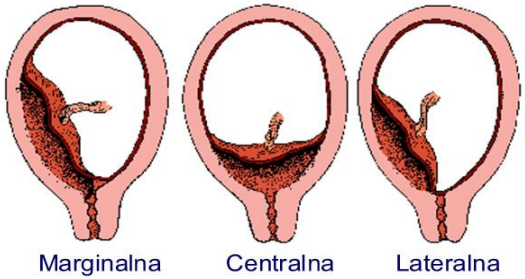
Ectopic Pregnancy

- It means implantation outside the uterine cavity (normally, it's near the fundus)
- 95 to 97% of ectopic pregnancies occurs in the uterine tube.
- Most are in the ampulla & isthmus.
- Could happen in
  - Placenta Previa
  - Tubal :is the most common type of ectopic pregnancy could lead to rupture of the tube and become abdominal pregnancy
  - Ovarian: is the least common type of ectopic pregnancy
  - Abdominal.
  - Pelvic
  - Cervical.



Placenta Previa:

- Implantation occurs in the lower uterine segment at which the placenta is below the fetus, During vaginal delivery the placenta will precedes the fetus and lead to hemorrhage
- PREGNANCY IN CERVIX MAY OCCUR: LEADS TO ANTEPARTUM HAEMORRHAGE & PLACENTA PREVIA
- Has 3 types:
  - Placenta previa centralis: the placenta anchor in internal os of the cervix
  - Placenta previa lateralis :in the lower part of the body of the uterus
  - Placenta previa marginalis :in the lower part of the body of the uterus and reach the cervix



Answers: [Q1:A] [Q2:A] [Q3:C] [Q4:C] [Q5:D] [Q6:C] [Q7:A] [Q8:D]

QUIZ

Q1: Fertilization mainly occurs in?

A. In ampulla of uterine tube

B. In isthmus of uterine tube

C. In uterine cavity

D. In the vagina

Q2: Which of the following happens immediately after fertilization?

A. Restore the diploid number

B. Formation of blastocyst

C. Become haploid

D. Beginning of 2nd meiotic

Q3: During implantation which one of the following structures will invade the endometrium?

A. Cytotrophoblast

B. Epiblast

C. Syncytiotrophoblast

D. Hypoblast

Q4: WHICH ONE OF THE FOLLOWING IS THE FIRST PHASE IN FERTILIZATION?

A. Passage of sperm through zona pelluida.

B. Fusion of male & female pronuclei.

C. Passage of sperm through corona radiata.

D. Fusion of plasma membranes of oocyte & sperm.

Q5: What is the normal site for Implantation?

A. Ampulla

B. Uterine tube

C. lateral wall of the body of the uterus

D. posterior wall of the body of the uterus

Q6: in which day the Implantation start ?

A. 7th day

B. 4th day

C. 6th day

D. 11th day

Q7: the outer cell layer of the Blastocyst called ?

A. trophoblast

B. blastocele

C. blastocystis

D. Morula

Q8: in which day the Uteroplacental circulation begins ?

A. 13th day

B. 7th day

C. 9th day

D. 11th day

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