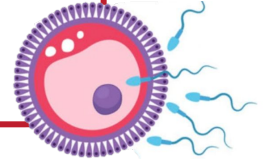


# Fertilization and Implantation

Reproductive block-Embryology-Lecture 5

Editing file



# 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.

**Color guide :**

Only in boys slides in **Green**

Only in girls slides in **Purple**

important in **Red**

Notes in **Grey**



# Fertilization

- It is the process during which a male gamete (sperm), and a female gamete (oocyte), unite together to form a single cell (ZYGOTE).
- 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**

## Phase of Fertilization

**1** **Passage** of the sperm through the cells of the **corona radiata** by the effect of:

- Hyaluronidase enzyme secreted from the sperms.
- By movement of its tail.

**2** **Penetration** of the **zona pellucida** by acrosine (a substance secreted from acrosomal cap)

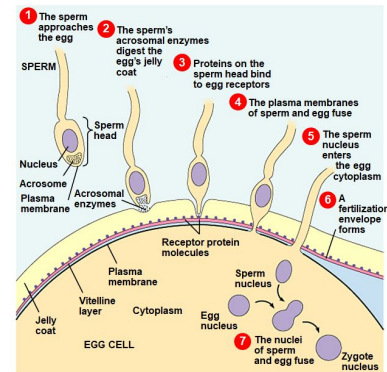
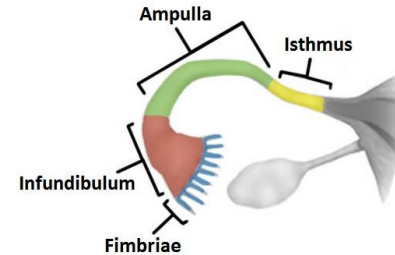
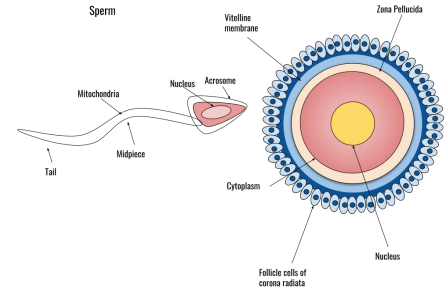
**3** **Fusion** of the plasma membranes of the oocyte and the sperm.

**4** **Completion** of the second meiotic division of the oocyte, which was arrested at (metaphase)

**5** **Formation** of the female pronucleus

**6** **Formation** of the male pronucleus.

**7** **Union** of the 2 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

## Results of Fertilization



1

It stimulates the penetrated oocyte to complete its 2nd meiotic division.

2

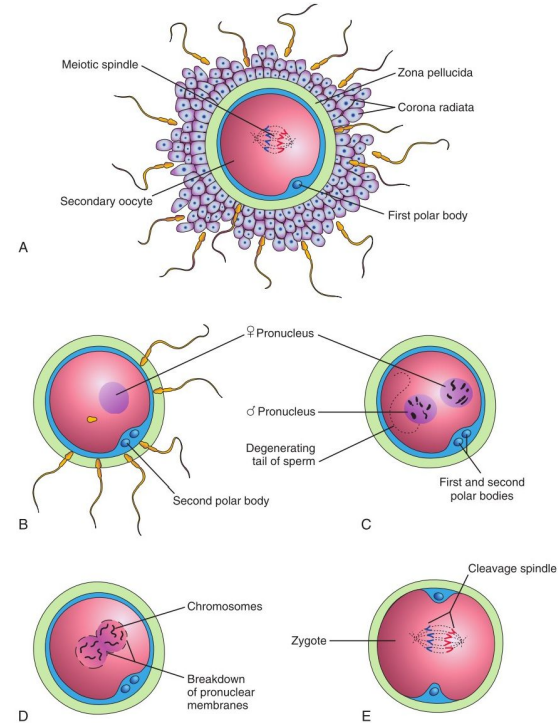
Restores the diploid number of chromosomes.

3

Determines the sex of the embryo.

4

Initiates cleavage of the zygote (cell division).

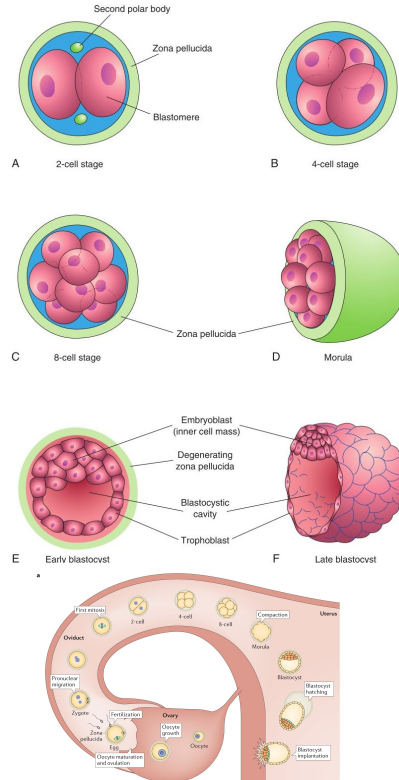


# Fertilization cont.

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**.
- 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
- **Zona pellucida is still found in this stage**

03

## Blastocyst

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

- Outer cell layer called trophoblast.
- Inner cell layer (mass) **called Embryoblast** attached to one of the poles of the blastocyst.

The cavity is called **blastocystic cavity** or **blastocoele**.

# Implantation

## Definition

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

## Site

Normal site of implantation is the **posterior wall of the body of the uterus** near the fundus.

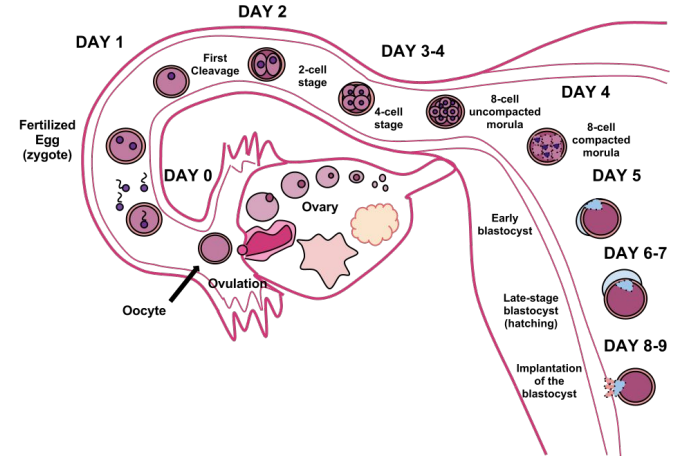
## Time

It begins about the **6th day** after fertilization and completed by the **11th or 12th day**

## Detection of Implantation

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

## 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 allow 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

blastocyst is superficially **embedded** in the compact layer of the endometrium

## By 10th or 11th day.

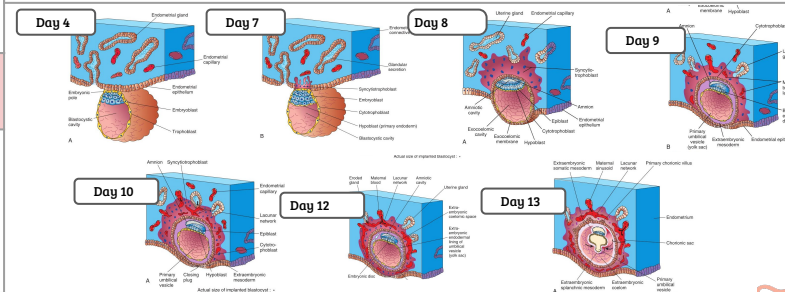
**Blood-filled Lacunae appear** within the Syncytiotrophoblast which communicate with each other forming a network

## 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

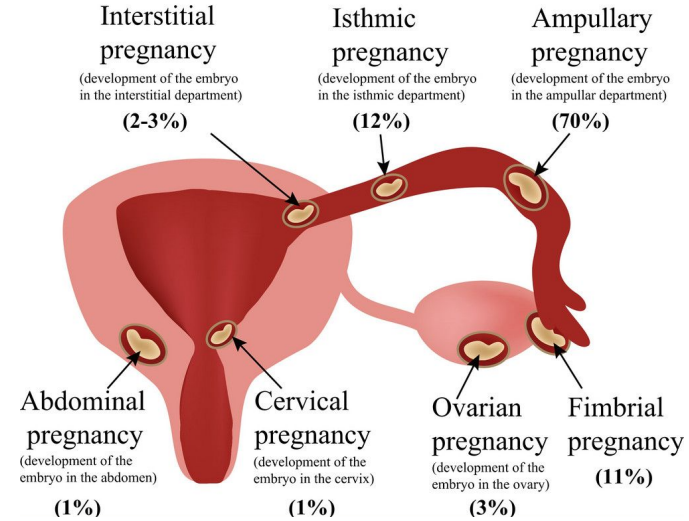
## By 13th day

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



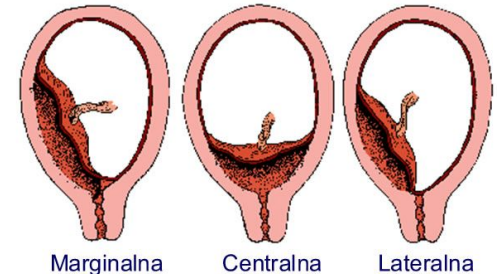
# Ectopic Pregnancy

- 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
  - Ovarian: is the least common type of ectopic pregnancy
  - Abdominal.
  - Pelvic
  - Cervical.



## Placenta Previa:

- Implantation occurs in the lower uterine segment
- 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





# QUIZ

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
A	A	C	B	D	C	A	D

**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:** 20-years-old woman presented to the clinic with late period, she was referred to the lab for blood investigations, which one of the following enzymes will be found?

- A. hSG
- B. hCG
- C. Estrogen

**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



# Members board



## Team leaders



**Abdulrahman Shadid**

• **Ateen Almutairi**

### Boys team:

- **Mohammed Al-huqbani**
- **Salman Alagla**
-  **Ziyad Al-jofan**
- **Ali Aldawood**
- **Khalid Nagshabandi**
- **Sameh nuser**
- **Abdullah Basamh**
- **Alwaleed Alsaleh**
-  **Mohaned Makkawi**
- **Abdullah Alghamdi**

### Girls team :

- **Ajeed Al Rashoud**
- **Taif Alotaibi**
- **Noura Al Turki**
- **Amirah Al-Zahrani**
- **Alhanouf Al-haluli**
- **Sara Al-Abdulkarem**
- **Renad Al Haqbani**
- **Nouf Al Humaidhi**
- **Jude Al Khalifah**
- **Nouf Al Hussaini**
- **Danah Al Halees**
- **Rema Al Mutawa**
- **Maha Al Nahdi**
- **Razan Al zohaifi**
- **Ghalia Alnufaei**

Contact us:

