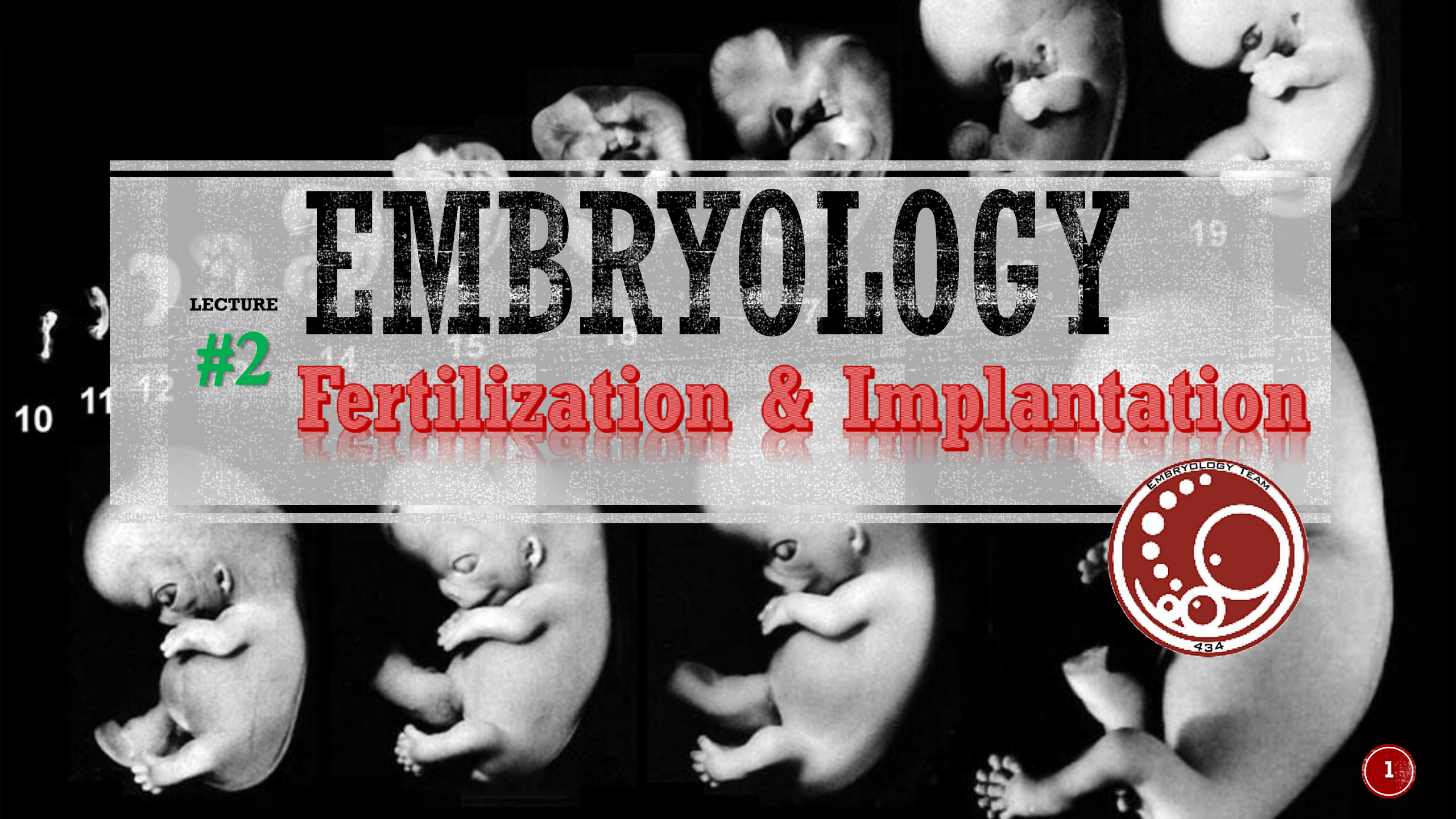

LECTURE

#2

EMBRYOLOGY

Fertilization & Implantation

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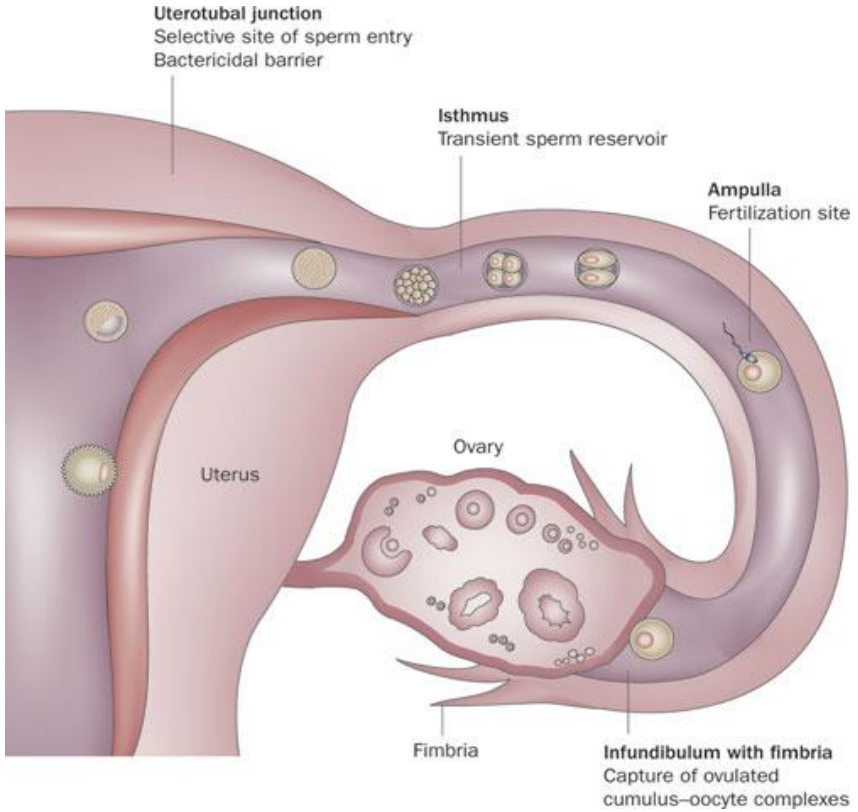
OBJECTIVES

By the end of the lecture, you should be able to:

- Define 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.
- Describe the formation of primary chorionic villi.
- List the sites of ectopic pregnancy.

#Fertilization :

- Definition: a male gamete (**sperm**) + a female gamete (**oocyte**) = a single cell called the **(ZYGOTE).**
- It is a complex process which begins with a **contact** between the sperm & ovum and it Ends up with **intermingling (mixing)** of the maternal and paternal chromosomes.
- Site of Fertilization: **Usually** in the **ampulla** (the widest part of the tube) of uterine tube.
- **Fertilization** may occur in any other part of tube. **But Never occurs in the uterine cavity.**
- **Chemical signal** (from oocyte) attracts the sperms.



- Phases of fertilization:

Passage

Passage of the sperm through the cells of the corona radiata by:

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

Penetration

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

Fusion

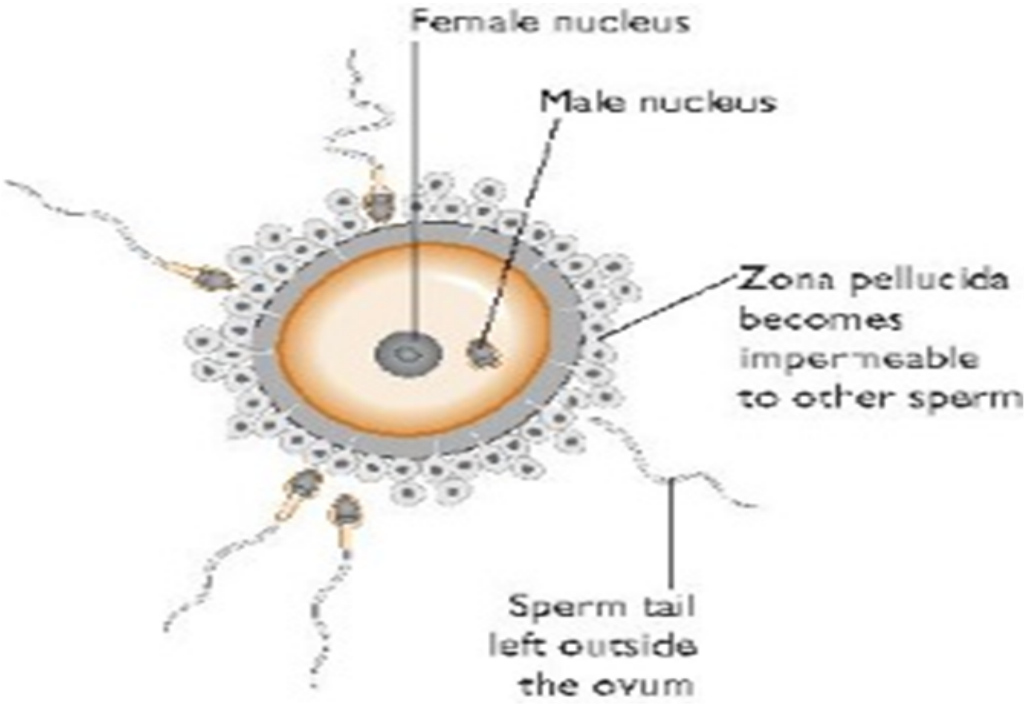
Fusion of the plasma membranes of the oocyte and the sperm.

Completion

Completion of the second meiotic division of the oocyte & **formation** of the **female** pronucleus.

Formation

Formation of the **male** pronucleus.



Results of Fertilization:

1) **Stimulates** the penetrated oocyte to complete its 2nd meiotic (which was arrested at metaphase) division.
2) **Restores** the **diploid** number of the chromosomes.
3) **Determines** the sex of the embryo.
4) **Beginning** of cleavage (cell division) of the zygote.

Sex of the Embryo:

- Embryo's sex is determined at the time of fertilization.
- Sex is determined by the type of sperm, **(X or Y)** that fertilizes the oocyte.
- So the **father's gamete** decides the sex.
- **Zonal reaction :** it is a change in properties of zona pellucida that makes it **impermeable** **(closed)** to other sperms.

Chromosomes:

- **½** of its **chromosomes** comes from the father and the **½** comes from the mother.
- This mechanism forms **biparental inheritance** and leads to variation of the human species.

#Cleavage of zygote

•Defenetion:

repeated mitotic divisions of the zygote.

•Place:

Normally occurs in the uterine (fallopian) tube.

•Function:

Rapid increase in the number of the cells.

•Result:

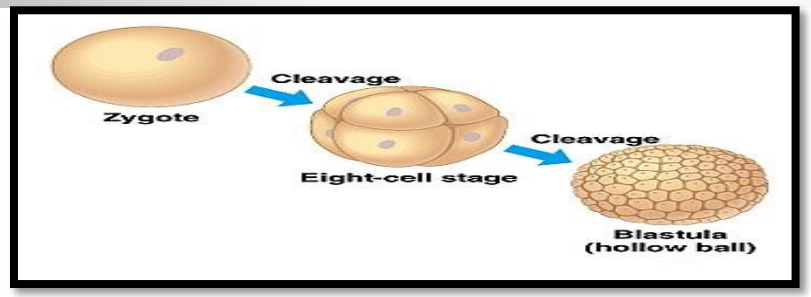
smaller embryonic cells are now called, **Blastomeres**.

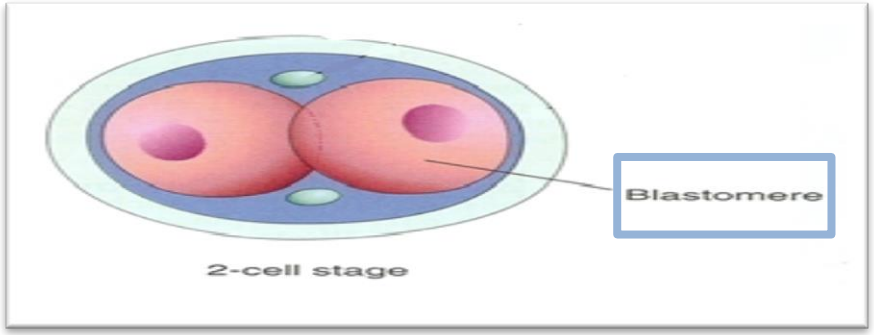
•Time:

It begins about **30** hours after fertilization

•Direction:

It migrates in the uterine tube during cleavage from lateral to medial.





○Remember:

-Zygote lies within the thick zona pellucida during cleavage.

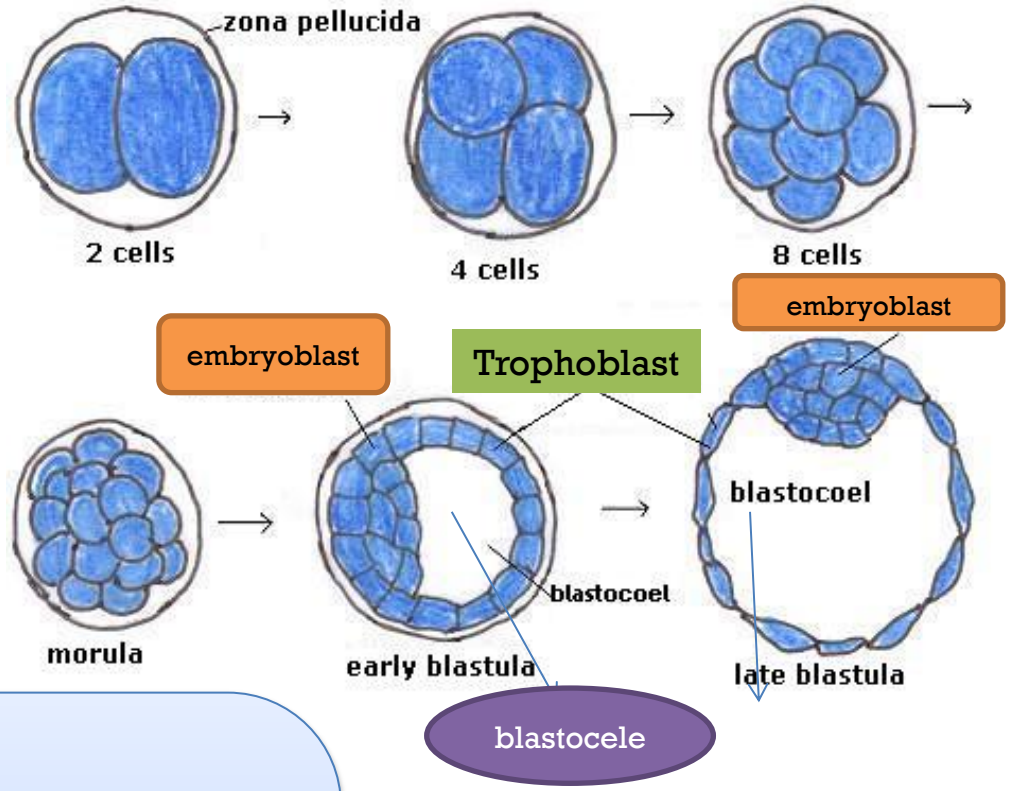
-Zygote divides into 2, then 4, then 8, then 16 Cells.

-Zonapellucida is translucent membrane under the light microscope.

❖Morula:

When there are 16-32 blastomeres the developing human, is called **MORULA**.

- it formed about 3 days after fertilization.
- It resembles mulberry or blackberry.
- The **Morula** reaches the uterine cavity at this stage in the **4th day**.



❖Blastocys:

Morula develops into blastocyst when
The Blastocystic **cavity** (**blastocele**) appears (due to Fluid passege from uterine cavity to the morula)
and divides the morula into:

(1)Outer cell layer (**Trophoblast**) and
(2)inner cell layer mass (**embryoblast**) or theembryonic pole.

#IMPLANTATION:

❖ **Definition:**

It is the process by which the Blastocyst penetrates the superficial (Compact) layer of the endometrium of the uterus.

❖ **Site:**

in the posterior wall of the uterus near the fundus.

❖ **Time:**

starts in : the 6th day after fertilization

completed in the : 11th -12th day

#Mechanism of implantation :

4th day
- The Morula reaches the uterine cavity after fertilization and remains free for one or two days.
- Fluid passes from uterine cavity to the Morula.
- Now the Morula is called **Blastocyst**, its cavity is called blastocystic cavity, its cells divided into Embryoblast&Trophoblast.

5th day
- **Zona pellucida** degenerates & disappears to allows the **blastocyst** to increase in size and penetrates the endometrium.

6th day
- **Blastocyst begins implantation by the 6th day.**
- the blastocyst *adheres* to the endometrium
- Trophoblast cells penetrate the epithelium of the endometrium (with the help of proteolyticenzymes(eg.COX-2) which is produced by the **trophoblast**.

7th day
- Trophoblast differentiated into 2 layers:
- a) Cytotrophblast, inner layer, mitotically active.
- B)Syncytiotrophoblast(outer multinucleated mass, with indistinct cell boundary) It erodes the endothelial lining of the maternal capillaries which are known as sinusoids with finger-like processes.

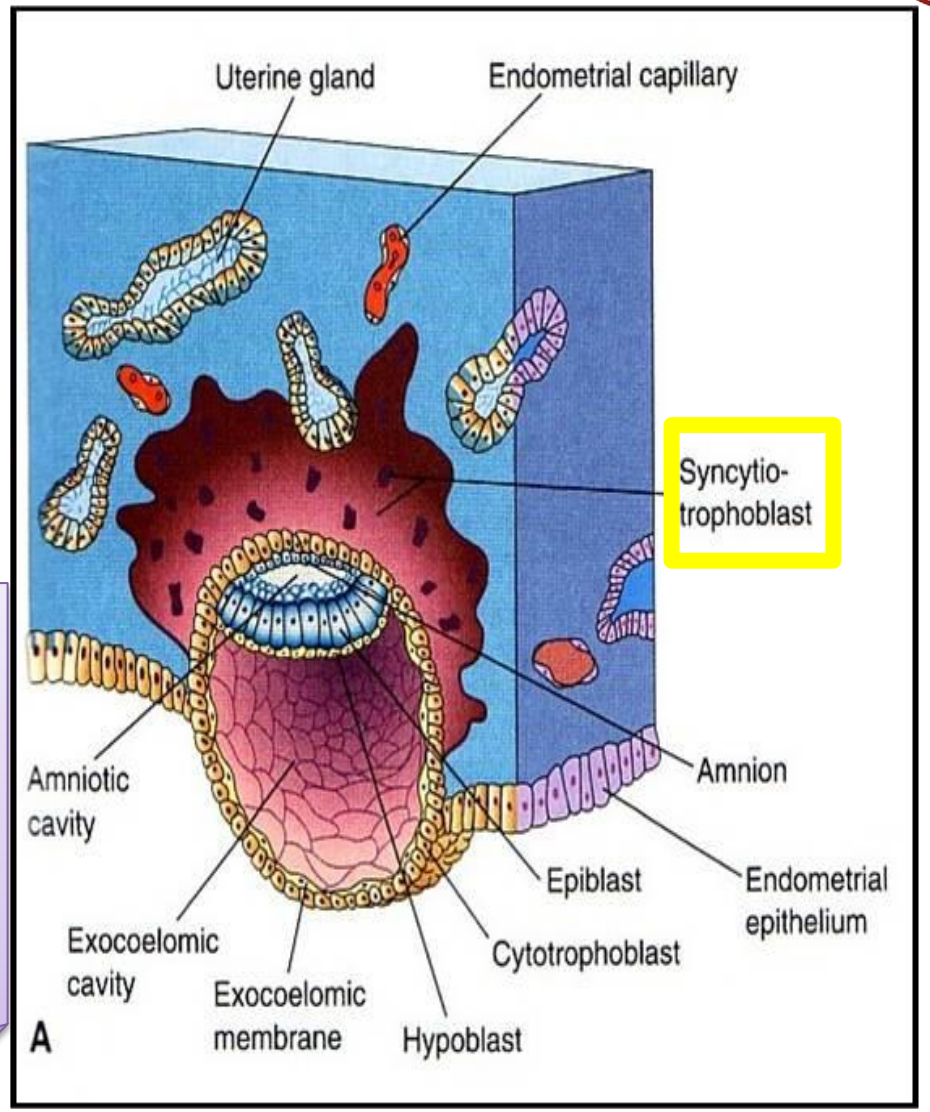
8th
- the blastocyst is superficially embedded in the compact layer of the endometrium

10th or 11th
- blood filled lacunae appears in the Syncytiotrophoblast that communicate forming a network.

11th or 12th
- blood of maternal capillaries reaches the lacunae so, **Uteroplacental circulation** is established

❖ Blood filled lacunae:

- appear in the **Syncytiotrophoblast** which communicate with each other forming a network by the **10th or 11th day.**
- Now, blood of maternal capillaries reaches the lacunae **Uteroplacental circulation** is established by 11th or 12thday.



❖ Remember:

-Endometrial cells undergo **apoptosis** (programmed cell death)to facilitate
invasion of endometrium by the Syncytiotrophoblast which engulf these degenerated cells for nutrition of the embryo.

-Implantation can be detected by:
1- Ultrasound
2- hCG (human chorionic gonadotrophin which is secreted by the Syncytiotrophoblast) about the **end** of 2nd week.

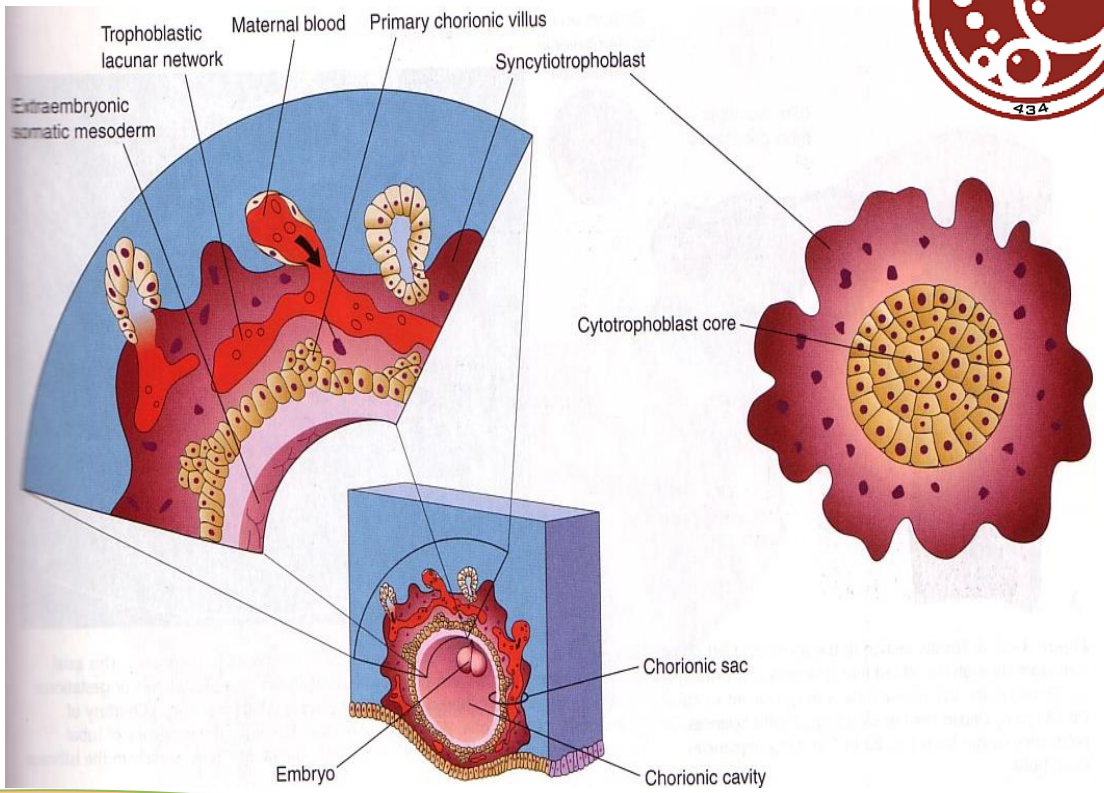
❖ Early pregnangcy factor:

•Is an immunosuppressant protein.

•Secreted by trophoblast cells.

•Appears in maternal serum within 24--48 hrs.

•It is the basis for **EPT** (Early pregnancy test) in the first **10** days of development.



Proliferation: Rapid increase in number.

Immunosuppressant: مثبط مناعي

❖ Formation of The Primary Chorionic villi:

By the 13th day *Proliferation* of Cytotrophblast cells produce extension inside the **Syncytiotrophoblast** to form the primary chorionic villi.

#Possible implantation sites and corresponding condition:

❖ **Ectopic Pregnancy:**

-It means implantation outside the uterine cavity.

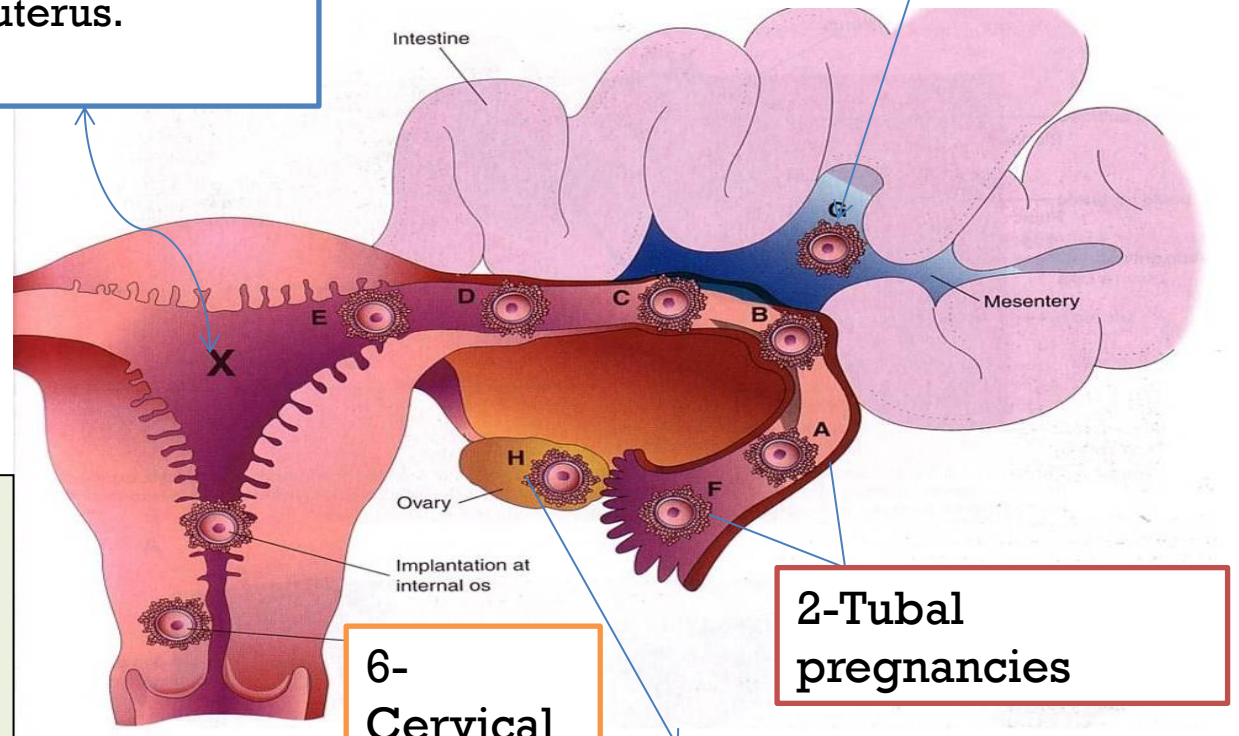
-95 to 97% of ectopic pregnancies occurs in the uterine tube.
Most are in the ampulla & isthmus.

-Placenta previa:

Implantation occurs in the lower uterine segment.

❖ **Normal site:**

occurs in posterior wall of endometrium of the uterus.



Ectopic Pregnancy:

1- Placenta Previa.
2- Tubal.
3- Ovarian.
4- Abdominal.
5- Pelvic.
6- Cervical.

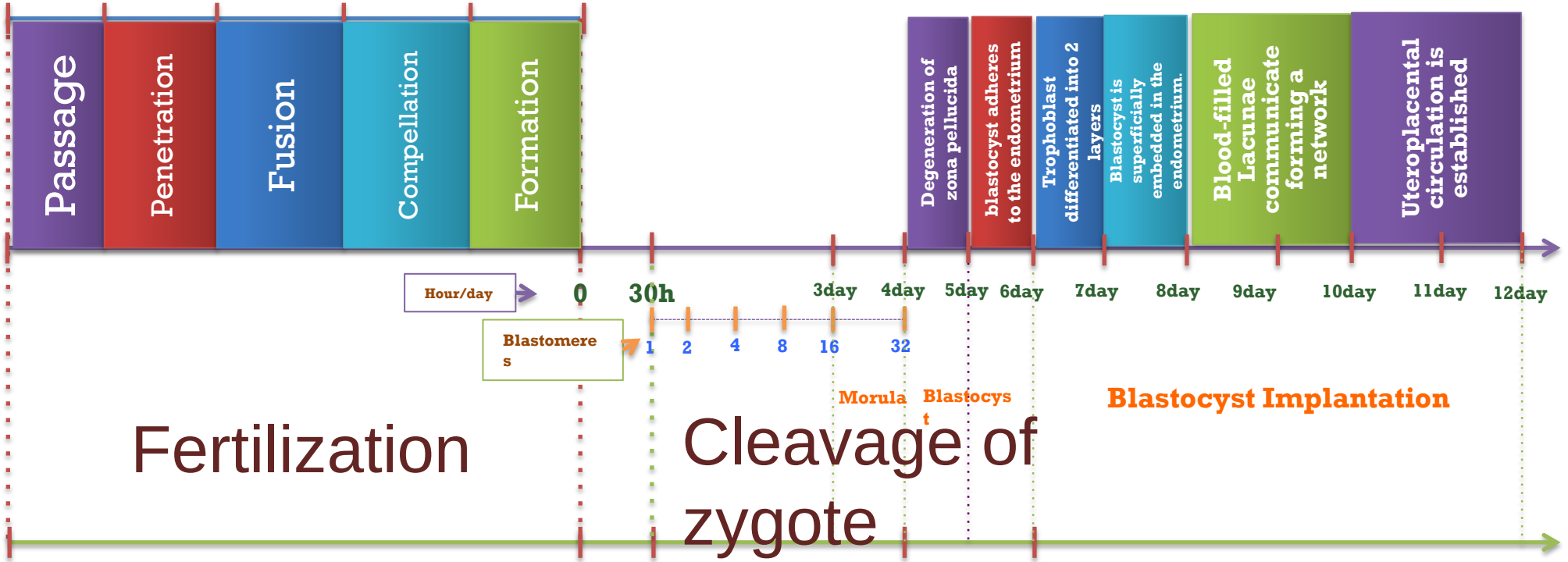
Fertilization Implantation

Phases

Luteal Phases

Time Line

Location



FERTILIZATION & IMPLANTATION AND TWINNING

FERTILIZATION

Definition:

- It is the process during which a male gamete (sperm) unites with a female gamete (oocyte) to form a single cell (ZYGOTE).
- Ends up with intermingling of the maternal and paternal chromosomes.
- It is a complex process,It begins with a contact between sperm & ovum.

Site of Fertilization

- Usually in the ampulla"widest part of the tube." of uterine tube
- Fertilization may occur in any other part of tube.But Never occurs in the uterine cavity.
- Chemical signal from oocyte attracts the sperms.

Phases of Fertilization

- 5- Formation of the male pronucleus
- 4- Completion of the second meiotic division of the oocyte & formation of the female pronucleus.
- 3- Fusion of the plasma membranes of the oocyte and the sperm.
- 2- Penetration of the zona pellucida by acrosine (a substance secreted from acrosomal cap).
- 1- Passage of the sperm through the cells of the corona radiata by the effect of:a) Hyaluronidase enzyme secreted from the sperms.b) By movement of its tail.

Results of Fertilization

- 1.Stimulates the penetrated oocyte to complete its 2nd meiotic division.
- 2.Restores the normal diploid number of chromosomes.
- 3.Determines the sex of the embryo.
- 4.Initiates cleavage (cell division) of the zygote.

Cleavage of Zygote

- It begins about 30 hours after fertilization.Zygote divides into 2, then 4, then 8, then 16 cells.Zygote lies within the thick zona pellucida during cleavage.Zygote migrates in the uterine tube during cleavage from lateral to medial.Under the microscope, the zona pellucida is a translucent membrane
- 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.

Ectopic Pregnancy

- It means implantation outside the uterine cavity.95 to 97% of ectopic pregnancies occurs in the uterine tube,Most are in the ampulla & isthmus

Early Pregnancy Factor

- Is an immunosuppressant protein.Secreted by trophoblast cells.Appears in maternal serum within 24--48 hrs., after fertilization,It is the basis for EPT (Early pregnancy test) in the first 10 days of development

IMPLANTATION

Definition

- It is the process by which the Blastocyst penetrates the superficial (Compact) layer of the endometrium of the uterus.

Site

- in posterior wall of the body of the uterus near the fundus.

Time

- It begins about the 6th day after fertilization.It is completed by the 11th or 12th day.

Mechanism

- By 7th day, Trophoblast differentiated into 2 layers: 1. Cytotrophblast, inner layer, mitotically active. 2. Syncytiotrophoblast (outer multinucleated mass, with indistinct cell boundary.
- By 8th day the blastocyst is superficially embedded in the compact layer of the endometrium.
- By 6th day the blastocyst adheres to the endometrium (A).
- Penetration results from proteolytic enzymes (eg.COX-2) produced by the trophoblast
- By the 5th day the Zona pellucida degenerates.
- Blastocyst begins implantation by the 6th day.
- Trophoblast cells penetrate the epithelium of the endometrium.
- The Morula reaches the uterine cavity by the 4th day after fertilization, & remains free for one or two days.
- Now the Morula is called Blastocyst, its cavity is called blastocystic cavity, its cells divided into Embryoblast & Trophoblast.

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 blastocele.

Morula

- When there are 16-32 blastomeres the developing human is called MORULA.The Morula reaches the uterine cavity at this stage.Spherical Morula is formed about 3 days after fertilization.It resembles mulberry or blackberry.

MULTIPLE CHOICES QUESTIONS

1. (16-32) embryonic cells are called:
a. Blastomeres.
b. Blastocyst.
c. Zona pellucida.
d. Morula.

3. Early pregnangcy factor is secreted by:
a. Chorionic villi.
b. Zona pellucida.
c. Embryoblast .
d. Syncytiotrophoblast

5.Regarding implantation all of the following are true, EXCEPT:
a. The blastocyst implants at its embryonic pole.
b. The cytotrophoblast erodes the endometrial tissues.

c. The implantation of the blastocyst can be detected by ultrasonography as early as the end of the second week.

d. The syncytiotrophoblast secretes human chorionic gonadotrophin hormone.

3.Blastocyst begins implantation by the __ day after fertilization.
a. 4th day
b. 6th day
c. 10-12th day
d. 1st day

4.Normal implantation site is:
a. Ovary
b. Abdominal
c. Utrinetube
d. posterior wall of endometrium of the utters

6.Which hormone can detect pregnancy in the mother's urine by the 2nd week?
a.Progesterone.
b.Early pregnancy factor.
c.Human chorionic gonadotrophin.
d.Estrogen

QUIZ LINKS
http://www.onlineexambuilder.com/fertilization-and-implantation/exam-8467

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