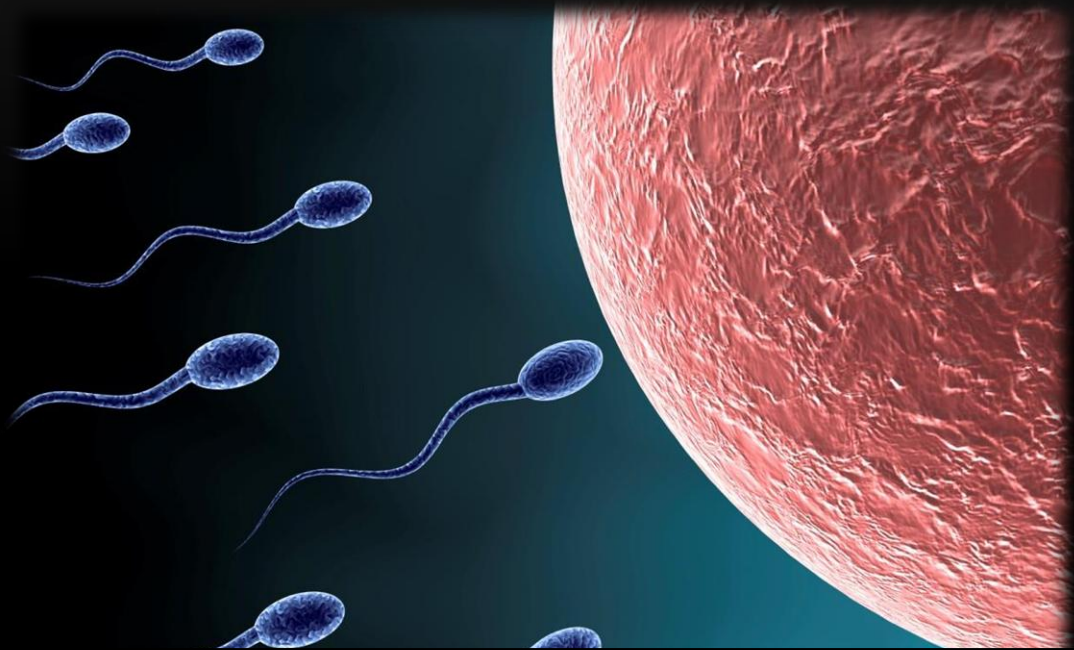


Embryology

Foundation Block



Lecture2 [FERTILIZATION & IMPLANTATION]

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Overview Timeline

30 h	cleavage of zygote	•
day 2	early pregnancy factors appear in maternal serum	•
day 3	formation of morula	•
day 4	morula reaches uterine cavity	•
day 5	zona pellucida degenerates	•
day 6	implantation begins	•
day 7	trophoblast is differentiated	•
day 8	blastocyst is superficially embedded in (compact) layer of endometrium	•
10-11	blood filled lacunae forming a network	•
11-12	implantation ends + uteroplacental circulation begins	•
13	formation of chorionic villi	•
14	week 2 human chorionic gonadotrophin (HCG) is secreted by Syncytiotrophoblast	•



FERTILIZATION & IMPLANTATION AND TWINNING

By the end of this lecture you should be able to know :

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

Good luck 😊

#Fertilization:

Definition: male gamete (sperm) + female gamete (oocyte) = (zygote)

- It is a **complex process** begins with a **contact** between sperm & ovum.
- Ends up with **intermingling (mixing)** of the maternal and paternal Chromosomes

* **Sperm:** can't live more than 48 hours.

* **Oocyte:** attracts the sperm with chemical signals.

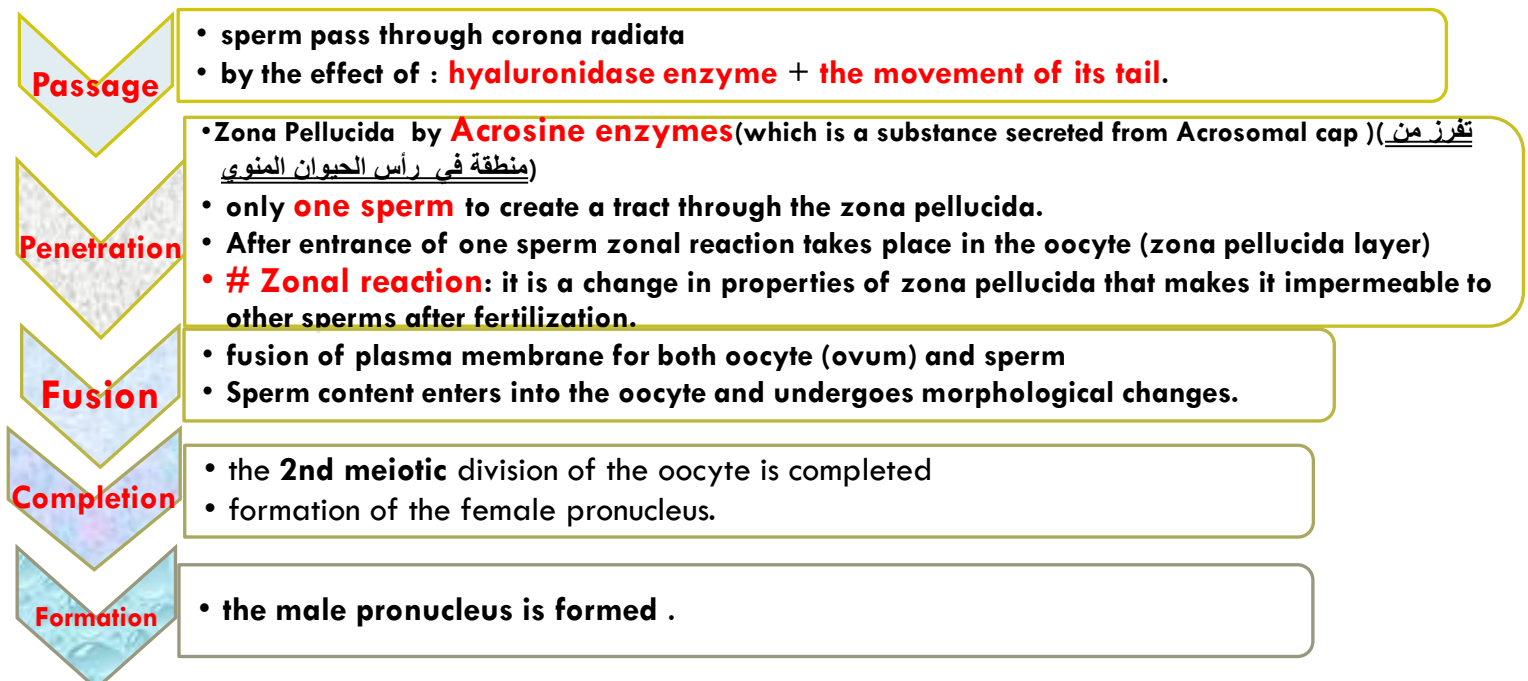
#Site of Fertilization:

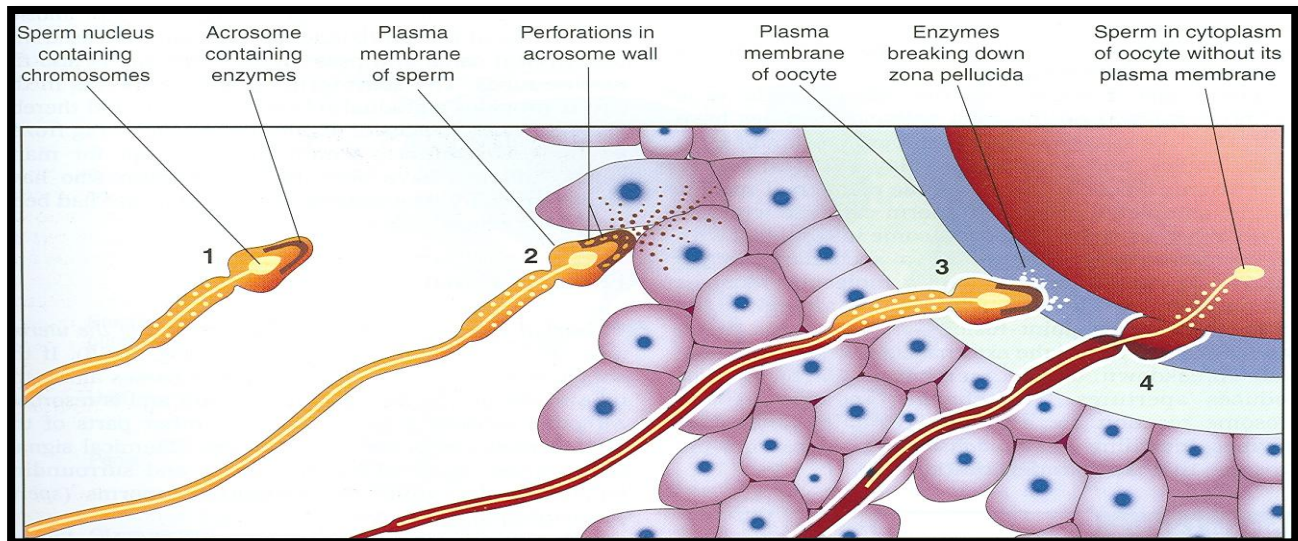
Usually in the ampulla of uterine tube (the widest part of the tube) and **may** occur in any other part of tube (**unlike the implantation that happen normally in one place**).

***Never occurs in the uterine cavity*.**

#Phases of Fertilization:

After attraction the sperm by the chemicals signals from oocyte:





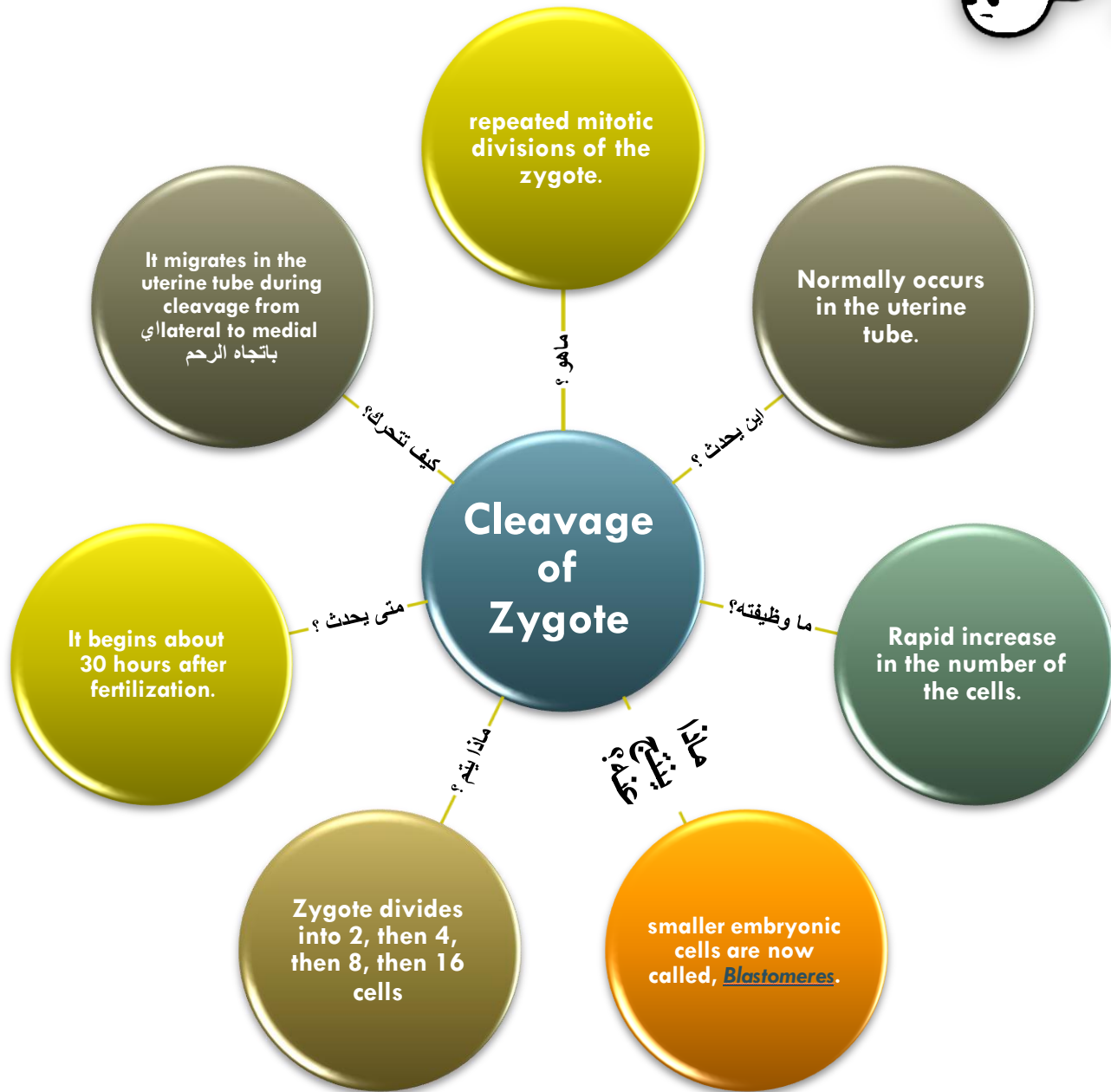
#NOTE: The mechanism **biparental inheritance** that leads to **variation** of the human species because of half of the chromosomes from father and half from mother.

A new combination is formed which is different from either of the parent

Sex of the embryo is determined at the time of fertilization or by type of sperm that fertilizes the oocyte (that's why the father who decides the sex)

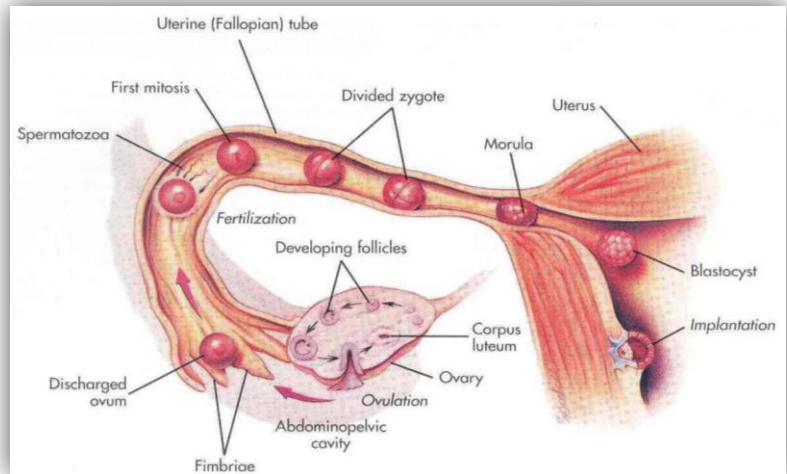
Results of fertilization:

- 1) **Stimulates** the penetrated oocyte to complete its 2nd meiotic division.
- 2) **Restores** the normal **diploid** number (46) of chromosomes.
- 3) **Determines** the chromosomal sex of embryo *by (the father's sperm either x or y)*
- 4) Initiates **cleavage** (cell division) of the zygote.

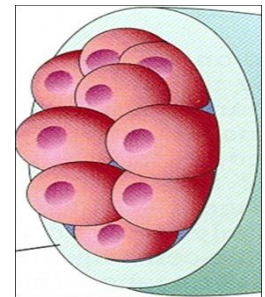
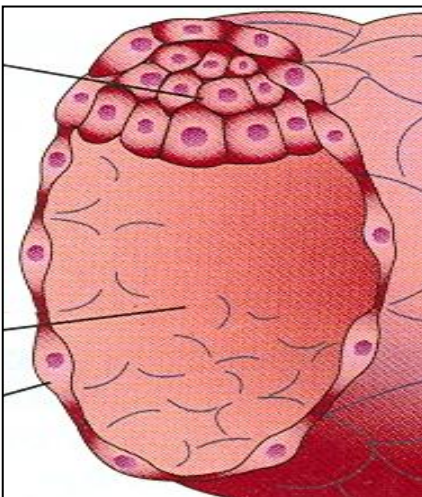


#NOTE:

- Zygote **lies within** the thick zonapellucida during cleavage.
- Zonapellucida is **translucent** membrane under the light microscope.

***Morula :**

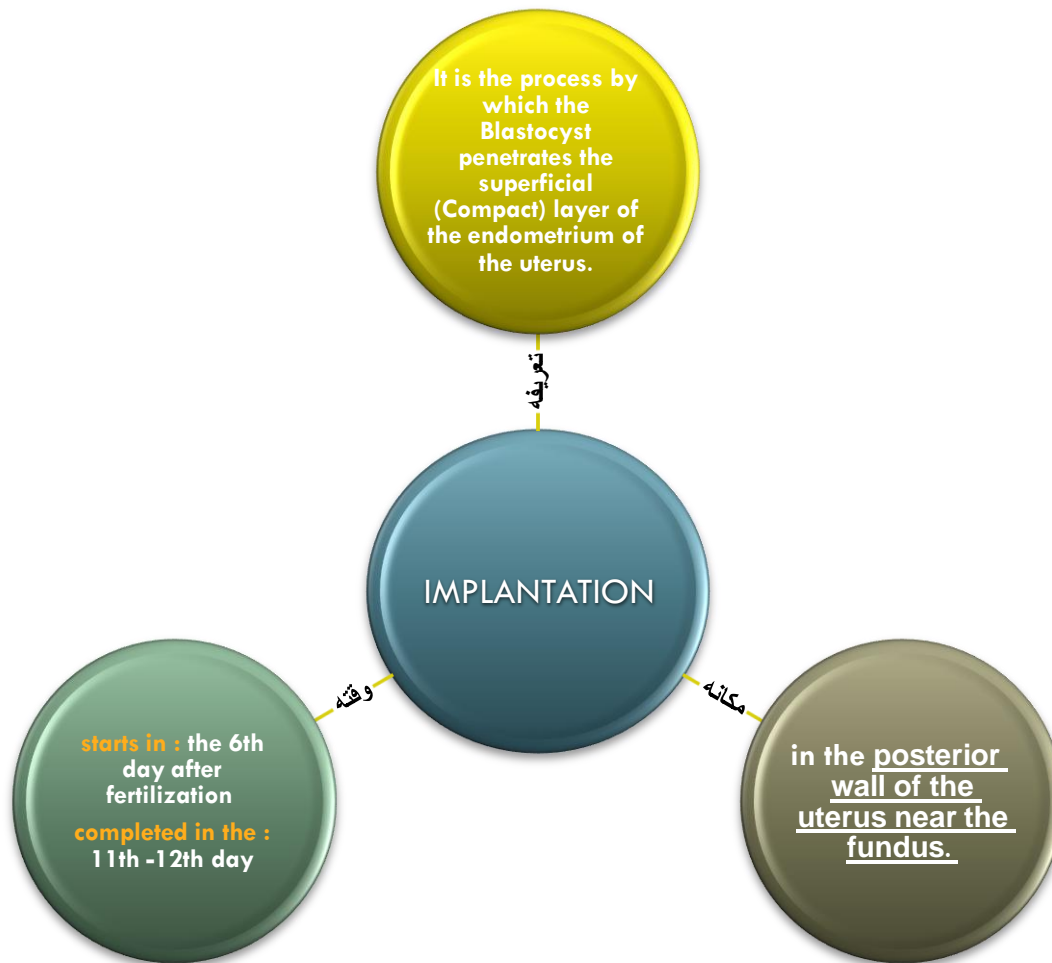
- **What is it?** When there are 16-32 blastomeres the developing human, is called **MORULA**.
- it formed about 3 days after fertilization.
- It resembles mulberry or blackberry.

***Blastocyst :***** What is it?**

Morula develops into blastocyst when

The Blastocystic cavity (blastocoel) appears and divides the morula into:

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



#Mechanism of implantation :

1. The **Morula** reaches the uterine cavity by the **4th** day after fertilization and remains **free** for one or two days.
2. **Fluid passes** from uterine cavity to the Morula.
3. Now the Morula is called **Blastocyst**, its cavity is called blastocystic cavity, its cells divided into **Embryoblast & Trophoblast**.
4. By the **5th** day the Zonapellucida **degenerates**. (لتسمح بالالتصاق.)
5. Blastocyst **begins implantation by the 6th** day.
6. Trophoblast cells penetrate the epithelium of the endometrium (with the help of **proteolytic enzymes** (eg. COX-2) which is produced by the trophoblast.

7. **By the 7th day, Trophoblast differentiated into 2 layers:**

a) **Cytotrophoblast**, 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.

8. By the 8th day the blastocyst is superficially embedded in the compact layer of the endometrium

9. By the 10th or 11th day blood filled lacunae appears in the **Syncytiotrophoblast**

10. that communicate forming a network.

11. by the 11th or 12th day blood of maternal capillaries reaches the lacunae so, Uteroplacental circulation is established

At day 12, the defect in the endometrial epithelium is filled by a closing plug (a blood clot)

#Blood-filled Lacunae:

What are they? They appear in the **Syncytiotrophoblast** which

communicate forming a network by the **10th or 11th** day.

* Now, blood of **maternal capillaries** reaches the lacunae

so, **Primitive uteroplacental circulation** is established by **11th or 12th** day.

#NOTE: 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 is detected by ultra **sound** & **hCG** secreted by the Syncytiotrophoblast about the end of 2nd week.

#Possible implantation sites and corresponding condition:

- **Normally** occurs in posterior wall of endometrium of the uterus.
- **Placenta previa**: implantation occurs in the lower uterine segment.
- **Extrauterine (Ectopic)**: ectopic pregnancy in (ovary-abdomen-cervical). 95% to 97% occurs in the uterine tube especially in the **ampulla** and **isthmus**.

#Early pregnancy factor:

- An **immunosuppressant** protein.
 - Secreted by **trophoblast** cells.
 - Appears in the maternal serum within **24-48 hours after fertilization**.
- * It is the basis of **EPT (early pregnancy test)** in the first 10 days of development.

#On the figure below:

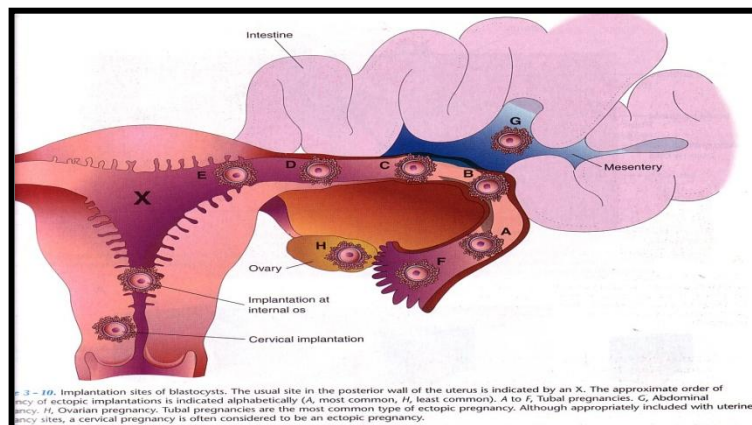
- **Normal site (X)**
- The approximate order of pregnancy **of ectopic implantations** is indicated alphabetically (**A**, most common, **H**, least common).

A to F, Tubal pregnancies. **G**, Abdominal pregnancy. **H**, Ovarian pregnancy.

Tubal pregnancies are the most common type of ectopic

Pregnancy. Although appropriately included with uterine pregnancy

site, a cervical pregnancy is often considered to be an ectopic pregnancy.



#Do you know?

***Fertilization:** is the process which a male gamete (sperm) join a female gamete (oocyte) to form a single cell (ZYGOTE).

Fertilization occurs in ampulla which is the widest part of the tube, and it may occur in another part of uterine tube, but it never occurs in the uterine cavity

***Biparental inheritance (diploid):** 50% chromosomes come from father, 50% from mother, and it's determined the sex (X or Y)

When there are 16-32 blastomeres in Zonapellucida is called MORULA

***IMPLANTATION:** which the Blastocyst penetrates the superficial (Compact) layer of the endometrium of the uterus.

***Syncytiotrophoblast:** erodes the endothelial lining of the maternal capillaries which known as sinusoids.

***Ectopic Pregnancy:** it means Implantation outside the uterine cavity, and it is usually in ampulla & isthmus.





Linkscanhelp:

Fertilization (Conception):

<https://www.youtube.com/watch?v=BFrVmDgh4v4>

implantation:

<https://www.youtube.com/watch?v=YcxQDkMpi6w>



Simple multiple-choice questions :

1. where does fertilization occur ?

A. urine cavity B. ovary C. ampulla

2. which one of the following is secreted by acrosomal cap for penetration?

A. acrosine B. Thyroxine C. Glucagon

3. Endometrial cells undergoes :

A. necrosis B. apoptosis C. adipose

4. Which cell is responsible for implantation?

A. trophoblast
B. Cytotrophoblast
C. Syncytiotrophoblast

5. Which cells are responsible for penetrating the epithelium of endometrium?

A. trophoblast
B. embryoblast
C. Blastocyst

6. Which cells are responsible for starting the implantation?

A. trophoblast
B. embryoblast
C. Blastocyst

Correct answers :

1-C 2-A 3-B 4-C

5-A 6-C