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Lecture title: Embryology introduction / Phase of fertilization

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Phase of fertilization

Fertilization : is a sequence of events that begin with the contact of a sperm (male gamete) with the secondary oocyte (female gamete) and ends with the fusion of their pronuclei (haploid nuclei of sperm and ovum) and mingling of their chromosomes to form a fertilized ovum known as the zygote ; which is a large diploid cell consider as the primordial of the individual (human or animal).

Types of fertilization :

1-Monospermic fertilization : fertilization that performed by penetration of only one spermatozoon into the egg (ovum) .

2-Polyspermic fertilization : more than one sperm enter the egg . It's has 2 types :

a/Pathological polyspermy .

b/Physiological polyspermy :as in birds and reptiles .

During ovulation , the secondary oocytes fall down from the ovary to infundibulum of uterine tube (oviduct) then to the ampulla of uterine tube where the fertilization normally occurs .

Secondary oocyte : is a haploid cell (1N) surrounded by thick amorphous membrane of glycoproteins known as zona pellucida , which

surrounded by the corona radiata cells (some of cumulus oophorous cells which break and float-out of ovary, rearrange themselves around zona pellucida forming corona radiata) .
Corona radiata persist in carnivores after ovulation, while corona radiata loosed during ovulation in ruminants.

How fertilization occur? (Stages of fertilization):

After sexual intercourse , a lot of sperms pass rapidly from the vagina into the uterus and subsequently into the uterine tube .This ascent of sperms occur by the aid of contraction of the smooth muscle in the uterus & uterine tube and the spontaneous movement of sperms' tails .

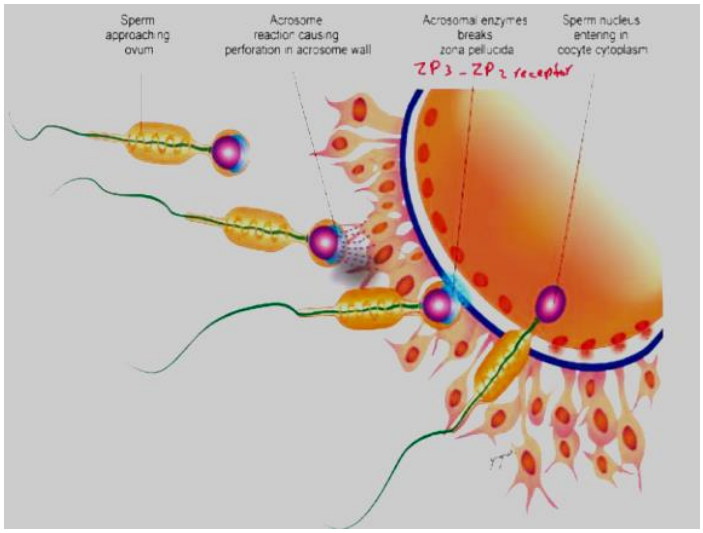
The sperms must go under capacitation and acrosome reaction to be able to fertilize the ovum **.**

***Capacitation :**

the period that sperms required to spend within the female genital tract to be able to fertilize the ovum (about 2-10 hours) , within this period physiological and chemical changes occur on the acrosome of the sperm. Complete of capacitation permits the acrosome reaction to occur .

***Acrosome reaction :**

once sperm approach the secondary oocyte the outer acrosomal membrane forms multiple fusion sites with the outer acrosomal membrane resulting in the formation of many small vesicles, the spermatozoon binds in a species-specific interaction with a glycoprotein receptor molecule, ZP3, in the zona pellucida. Binding of the spermatozoon to the zona triggers the progressive breakdown and fusion of the spermatozoan cell membrane resulting in the release of enzymes which include hyaluronidase (cause separation and sloughing of the corona radiata cells that surround the ovum) and acrosin and neuraminidase. Releasing of enzymes and the vigorous motility of the spermatozoon facilitate penetration of the zona pellucida .once sperm binding with oocyte it will stimulate the 2nd meiotic division.

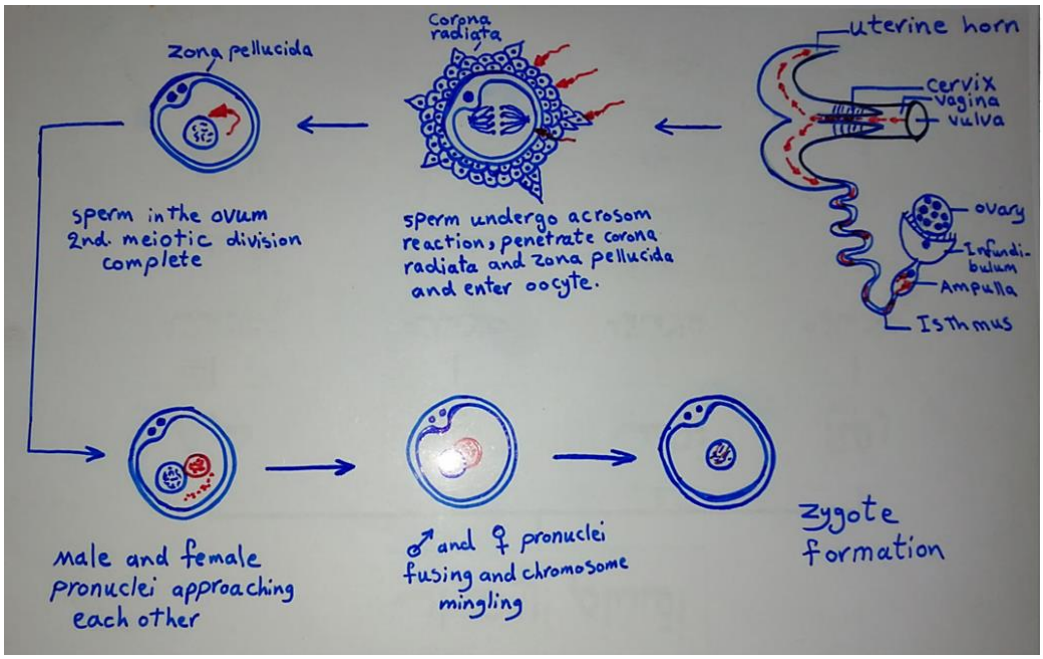


***Zona reaction :**

physiological changes occur in zona pellucida that surround the secondary oocyte as soon as the sperm contacts the plasma membrane of the secondary oocytes . This physiological changes prevent naturally the additional sperms from entering the secondary oocyte . This

process prevent polyspermy (fertilization by more than one sperm) from occur

After the sperm nucleus enters the cytoplasm , the large male pronucleus and small female pronucleus migrate towards each other , their nuclear envelopes disperse which allow the chromosome to pair up (mingling) so the zygote formed .

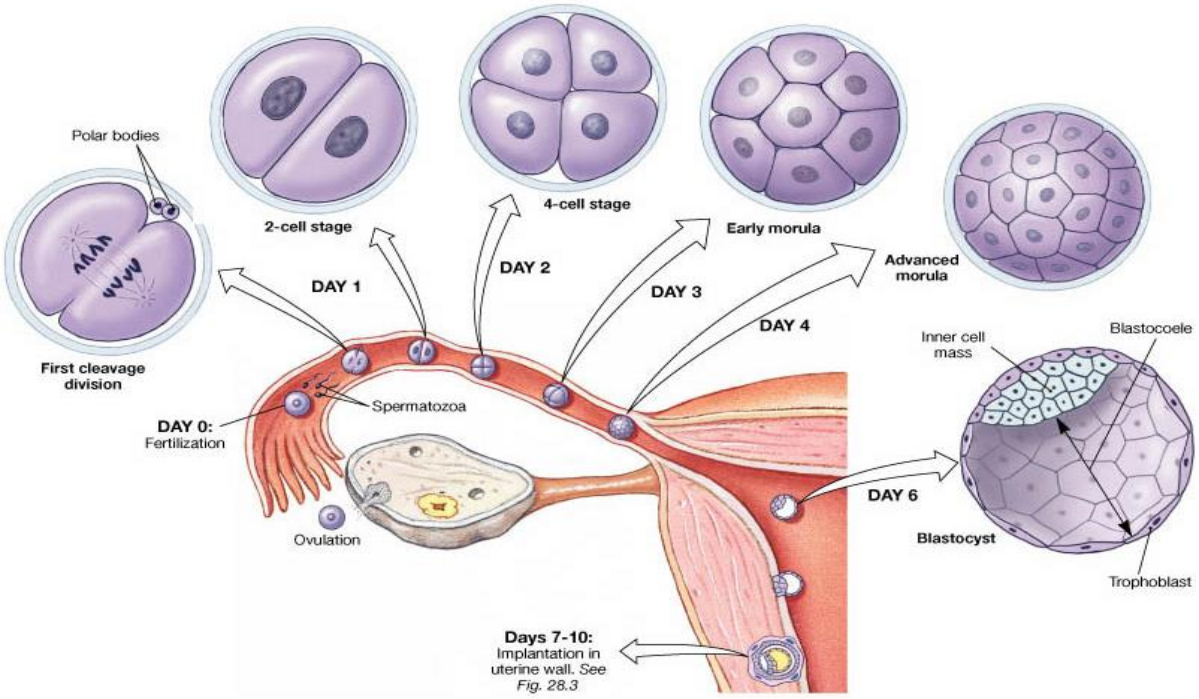


Results of fertilization :

1-Restoration the diploid number of chromosomes (46) .
2-Determination the chromosomal sex of the embryo .
3-Determination of variation characters .
4-Initiation of cleavage ; the mitotic cell division of zygote without an increase in cell mass .

2=Phase of cleavage

Cleavage consists of repeated mitotic divisions of the zygote, resulting in a rapid increase in the number of cells (blastomeres). Division of the zygote begins approximately 24 hours after fertilization. These blastomeres become smaller with each cleavage division. During cleavage, the zygote is still surrounded by the zona pellucida. After the eight-cell stage, the blastomeres change their shape and tightly align themselves against each other compaction. This phenomenon may be mediated by cell surface adhesion glycoproteins. Compaction permits greater cell-to-cell interaction and is a prerequisite for segregation of the internal cells that form the inner cell mass. When there are 16 to 32 blastomeres, the conceptus is called a morula. The inner cells of the morula.



Cleavage : is complete in mammals and incomplete in birds and fish

***Morula : is a mulberry-like cell cluster , each cell called blastomere, (16 blastomeres in human and 32-64 blastomeres in farm animals) .Cell membrane of morula, is still surrounded with the protective layer called the zona pellucida.**