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Course Title: Embryology

DEPARTMENT: Medicine and surgery

1. Discuss ovulation

Ovulation is the release of aa secondary oocyte from the ovarian follicle triggered by a surge of Luteinizing hormone(LH) production. A few days before ovulation, under the influence of increased Follicle Stimulating Hormone(FSH) and LH, the secondary follicle grows rapidly to a diameter of about 25mm to become a Graafian follicle.

Around the middle of the ovarian cycle, the ovarian follicle under the influence of FSH and LH undergoes a sudden growth spurt, producing a cystic bulge on the surface of the ovary. A small avascular spot, **the stigma**, soon appears on this swelling. Ovulation usually follows the LH peak by 12 to 24 hours.

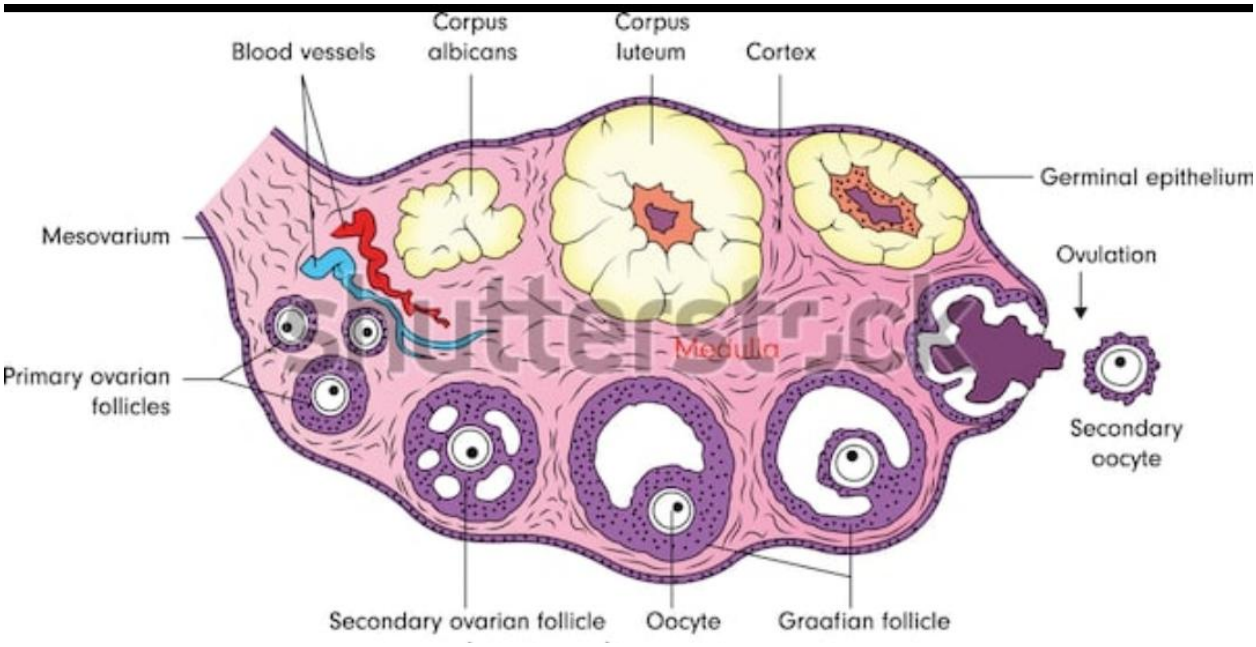
The LH surge/ peak elicited by the high estrogen level in the blood, causes the stigma to balloon out, forming a vesicles. The stigma soon ruptures, expelling the secondary oocyte with the follicular fluid.

Expulsion of the oocyte from the ovary is as a result of:

- Increased intrafollicular pressure
- Increase in prostaglandin levels owing to the LH surge which brings about contraction of the smooth muscle in the theca externa.
- The LH surge also increases collagenase activity resulting in the digestion of collagen fibres surrounding the follicle.

The expelled secondary oocyte is surrounded by zona pellucida and one or more layers of follicular cells, which are radially arranged as the corona radiata, forming the oocyte-cumulus complex.

The LH surge also seems to induce resumption of the first meiotic division of the primary oocyte.



1. <u>Differentiate between meiosis I and meiosis II</u>

Meiosis I	Meiosis II
Synapsis occurs	No synapsis
Centromeres do not split	Centromeres split
Involves 46 homologous duplicated chromosomes	Involves 23 homologous duplicated chromosomes
Crossing over occurs	There is no crossing over
Formation of 23 duplicated chromosomes at telophase II	Formation of 23 single stranded chromosomes at telophase II
Homologous chromosomes separate	Sister chromatids separate
Involves reduction of number of chromosomes	Involves division of remaining chromosomes

2. Discuss the stages involved in fertilization

   Fertilization is the union of the sperm and oocyte. The fertilization process takes approximately 24 hours. The usual site of fertilization is the ampulla of the uterine tube. The stages involved include:

   I. Passage of a sperm through the corona radiata:

   For sperms to pass through the corona radiata, they must have been capacitated (removal of the glycoprotein coat and seminal plasma proteins from the surface of the sperm acrosome). Only capacitated sperms can pass freely through the corona radiata.

II. Penetration of the zona pellucida:

The zona is a glycoprotein shell surrounding the egg that facilitates and maintains sperm binding and induces the acrosome reaction. The acrosome of the capacitated sperm binds to a glycoprotein on the zona pellucida. The acrosome reaction of sperm must be completed before the sperm can fuse with the oocyte. When capacitated sperm comes in contact with the corona radiata surrounding a secondary oocyte, they undergo complex molecular changes that result in the development of perforations in the acrosome. Release of acrosomal enzymes such as hyalurondinase and acrosin allows sperm to penetrate the zona pellucida, thereby coming in contact with the plasma membrane of the oocyte. As soon as the head of a sperm comes in contact with the oocyte surface, the permeability of the zona pellucida changes. When a sperm comes in contact with the oocyte surface, lysosomal enzymes are released from cortical granules lining the plasma membrane of the oocyte. In turn, these enzymes alter properties of the zona pellucida to prevent sperm penetration and inactivate binding sites for spermatozoa on the zona pellucida surface.

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

The plasma or cell membranes of the oocyte and sperm fuse and break down at the area of fusion. The head and tail of the sperm enter the cytoplasm of the oocyte, but the sperm's plasma membrane remains behind .

IV. Completion of the second meiotic division of oocyte and formation of female pronucleus:

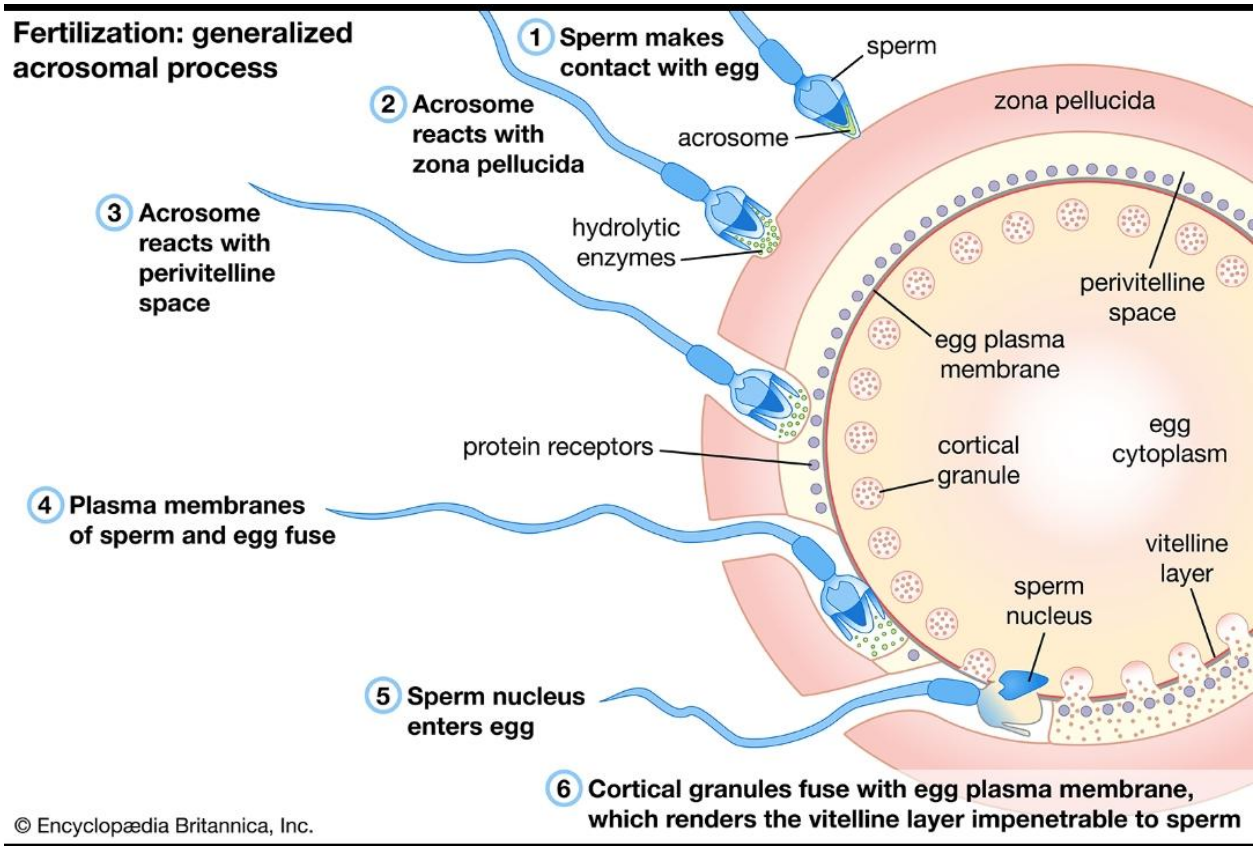
Penetration of the oocyte by a sperm activates the oocyte into completing the second meiotic division and forming a mature oocyte and a second polar body. The nucleus of the mature ovum is now called the female pronucleus

V. Formation of the male pronucleus:

Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus and the tail of the sperm degenerate. Since all sperm mitochondria degenerate, all mitochondria within the zygote are of maternal origin. Morphologically, the male and female pronuclei are indistinguishable. The oocyte now contains 2 pronuclei, each having haploid number of chromosomes(23). The oocyte containing two haploid pronuclei is called an ootid.

VI. Fusion of the 2 pronuclei into a single diploid aggregation of chromosomes, the ootid becomes a zygote:

The chromosomes in the zygote become arranged on a cleavage spindle in



preparation for cleavage of the zygote

3. Differentiate between monozygotic and diagnostic twins

Monozygotic twins	**Dizygotic twins**
Each twin develop in it's own amniotic sac, same chronic sac and share common placenta-monochorionic-diamniotic twin placenta	They are diamniotic, dichorionic with two placenta being more common than a single share placenta.
They are seen as conjoined twins	Occurrence as conjoined twins has not been recorded.
They are of the same sex	They are of different sexes
They are genetically identical with very similar physical appearance	They are no more alike genetically than brothers or sisters born at different times
Develop from a single zygote	Develop from 2 zygotes