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DEPARTMENT: MEDICINE AND SURGERY

ASSIGNMENT: EMBRYOLOGY

1. Discuss ovulation

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 swelling or bulge on the surface of the ovary. A small avascular spot, the stigma soon appears on this swelling. Before ovulation, the secondary oocyte and some cells of the cumulus oophorus detach from the interior of the distended follicle.

 Ovulation is triggered by a surge of LH production. Ovulation usually follows the LH peak by 12 to 24 hours. The LH surge, elicited by the high estrogen level in the blood, appears to cause the stigma to balloon out, forming a vesicle. The stigma soon ruptures, expelling the secondary oocyte with the follicular fluid. Expulsion of the oocyte is the result of intrafollicular pressure and possibly by contraction of smooth muscles in the theca externa [sheath] owing by stimulation by prostaglandins.

 Mitogen activated protein kinases 3 and1 also known as extracellular signal regulated kinases 1 and 2 in ovarian follicular cells seem to regulate signaling pathways that control ovulation . Plasmins and matrixs metalloproteins appear also to play a role in controlling rupture of the follicle .The expelled secondary oocyte is surrounded by the zona pellucida and one or more layers of follicular cells , which are the radially arranged as corona radiata ,forming the oocyte , hence , mature ovarian follicles contain secondary oocytes .The zona pellucida is composed by three glycoprotein [ZPA,ZPB,AND ZPC], which usually form a network of filaments with multiple pores . Binding of the sperm to the Zona pellucida[sperm fertilization.

1. Differentiate between meiosis1 and meiosis 2:

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| MEIOSIS 1 | MEIOSIS 2 |
| It is a reductive division  | It is an equational division |
| Crossing over occurs | Crossing over is absent |
| Chiasma formation occurs | Chiasma formation is absent |
| Formation of 2 daughter cells  | Formation of 4 daughter cells |
| Homologous chromosome pairs separate  | Sister chromatids seperate |
| Prophase split into 5 sub-phases | Prophase does not have sub-phases |
| Starts as diploid; ends as haploid. | Starts as haploid; ends as haploid. |

1. Discuss the stages involved in fertilization

**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 plasma membrane that overlies the acrosomal region of the spermatozoa)
1. **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 intact acrosome of the sperm **binds** with a zona glycoprotein (ZP3/ zonaprotein 3) on the zona pellucida
* *Release of acrosomal enzymes (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 pellicida surface
* only one sperm seems to be able to penetrate *the* oocyte

**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/oocyte is now called the f**emale pronucleus**
1. **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 degenerates

**Note**

* Since all sperm mitochondria degenerate, all mitochondria within the zygote are of maternal origin (i.e., all mitochondrial DNA is 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**
1. **The 2 pronuclei fuse 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.
1. Differentiate between monozygotic twins and dizygotic twins

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| --- | --- |
| Monozygotic twins | Dizygotic twins |
| Form from single zygote | Form from two zygote |
| Incidence is more common | Incidence is less common |
| Genetically identical | Genetically not identical |
| Twins are of the same sex | Twins are of the same sex or different sex |
| Resemblance is similar | Resemblance is not similar |
| Mostly diamniotic, monochorionic with single placenta | Mostly have two amnions two chorions, and two placenta |
| They are often called conjoined twins | They are not called conjoined twins |