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**COLLEGE:** MEDICINE AND HEALTH SCIENCES.

**DEPARTMENT:** MEDICINE AND SURGERY (200 LVL).

**Course Code:** ICBCS

**Assignment Title:** Embryology.

**ASSIGNMENT:** Question:

1. Discuss Ovulation.
2. Differentiate between meiosis 1 and meiosis 2.
3. Discuss the stages involved in fertilization.
4. Differentiate between monozygotic and dizygotic twins.

Answers:

Question 1:

**Ovulation**: This is the release of an oocyte from the ovarian follicle.

* In a few days before ovulation, under the influence of **FSH** (follicle stimulating hormone) and **LH** (Luteinizing Hormone), the secondary follicle grows rapidly to a diameter of about **25 mm** to become **mature vesicular/ mature secondary or Graafian follicle.**
* Coincident with final development of the vesicular follicle, there is an abrupt increase in **LH** that causes;
1. the primary oocyte to complete meiosis I
2. and the follicle to enter the **preovulatory mature vesicular stage**.

Meiosis II is also initiated, but the **secondary oocyte** is arrested in **metaphase** approximately **3 hours before ovulation**

Meanwhile, the surface of the ovary begins to bulge locally, and at the apex, an avascular spot, the **stigma, appears.**

* For the oocyte to be released, 2 events occur which are caused by LH surge:
1. it increases **collagenase activity**, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle
2. **Prostaglandin levels** also increase in response to the LH surge and cause local muscular contractions in the ovarian wall.

Those contractions extrude the oocyte, which together with its surrounding follicular (granulosa) cells from the region of the cumulus oophorus, this causes ovulation in which oocyte floats out of the ovary.

Some of the **cumulus oophorus cells** then rearrange themselves around the **zona pellucida** to form the **corona radiata**

Note:

Ovulation is triggered by a surge of LH production and it 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.

**Clinical Correlates:**

* During ovulation, some women feel a variable amount of abdominal pain called **mittelschmerz** also known as **middle pain** because it normally occurs near the middle of the menstrual cycle.
* In these cases, ovulation results in slight bleeding into the **peritoneal cavity**, which results in sudden constant pain in the lower abdomen.
* Mittelschmerz may be used as a symptom of ovulation, but there are better symptoms, such as the slight drop in basal body temperature
* Other signs of ovulation include:
1. Changes in cervical mucous.
2. Increased libido/urge for sex.
3. Tenderness of the breast.
4. Swollen vagina/vulva.
* Some women fail to ovulate, this is called **anovulation**, because of a low concentration of gonadotropins. In these cases, administration of an agent to stimulate gonadotropin release and hence ovulation can be employed.
* Although such drugs are effective, they often produce multiple ovulations, so that the risk of multiple pregnancies is 10 times higher in these women than in the general population.

Question 2:

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| **Differences between meiosis 1 and meiosis 2** |
| Homologous chromosomes separate | Sister chromatids separate |
| 2 diploid daughter cells | 4 haploid daughter cells |
| Genetic recombination (crossing over) occurs | Genetic recombination doesn’t occur. |
| A complex division and takes more time | Simple and takes less time |
| Preceded by Interphase | No interphase takes place. |
| Reduces the chromosome number in the daughter cell | Equalizes the chromosome number of both parent and daughter cells |
| It is a heterotypic division. | It is a homotypic division. |

Question 3: Stages Involved in Fertilization:

1. 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). It should be noted that **only capacitated sperms** can pass freely through the corona radiata.
2. 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 sperm **binds** with a zona glycoprotein (ZP3/ zonaprotein 3) on the zona pellucida.

The 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, 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.
1. 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.**

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

The 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. 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.**

Question 4:

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| Differences between monozygotic and Dizygotic twins. |
| Produced from the same zygote i.e. the division of a single zygote to give two embryos. | Produced from the formation of two zygote and this gives rise to two embryos. |
| They are genetically identical. | Not genetically identical. |
| Have the same sex. | Can be of different sexes. |
| Arise from one sperm. | Two different sperm fertilize two different oocytes. |
| Blood types are the same. | Blood types are different. |
| Genetic codes are nearly identical. | Genetic codes are same as any other sibling. |