ADJENE OGHENETEGA DIVINE

18/MHS01/027

1. **Discuss Ovulation**

Ovulation is the release of secondary oocyte (or ovum) from the ovarian follicle. Understanding ovulation requires understanding of the processes leading to the formation of the secondary oocyte, which is Oogenesis.

Oogenesis is the sequence of events by which oogonia differentiate into mature oocytes. It begins before birth and is completed after puberty.

The oogonia are formed from primordial germ cells which have migrated from the yolk sac walls, to the female gonads, at about the 5^{th} week of development. The oogonia divide mitotically to form primary oocytes. The primary oocytes formed are surrounded by a single layer of flattened, follicular epithelial cells. The follicular cells secrete oocyte inhibitor factor which arrests the primary oocyte in the prophase of Meiosis I. The oogonia continue to divide and reach their maximum value of about 7 million during the 5^{th} month. When this happens, most of them begin to degenerate. At the 7^{th} month, most have degenerated with about a few left on the surface. All the primary oocytes and the surrounding follicular cells are called primordial follicles.

As the primary oocyte enlarges during puberty, the surrounding flat, follicular epithelial cells become cuboidal in shape and then columnar. They then proliferate to produce a layer of granulosa cells around the primary oocyte, forming a primary follicle. Also, the follicular cells and the oocyte secrete a layer of glycoproteins on the surface of the oocyte, to form the zona pellucida. As the primary follicle continues to grow, the surrounding connective tissue organizes into a capsule, called the theca folliculi. As the primary follicle continues to grow, the theca folliculi differentiates into an inner secretory layer known as theca interna, and an outer fibrous capsule, known as theca externa.

As development continues, fluid filled spaces form between the granulosa cells. These spaces gradually coalesce to form the antrum. At first, the antrum is crescent shaped, but it eventually enlarges. When this large cavity forms, the whole structure is now called vesicular or secondary follicle. The accumulation of fluid in the space pushes the primary oocyte closer to the follicular walls. It is surrounded by numerous follicular cells, known as the cumulus oophorus. The secondary/vesicular follicle continues to grow rapidly and matures, having a diameter of about 25mm or more. At maturity, it is called the mature vesicular or mature secondary, or Graafian follicle. This happens before ovulation, under the influence of Follicle-stimulating hormone (FSH) and Luteinizing hormone (LH).

There is a sudden rise in LH which coincides with the development of vesicular follicle. This causes the arrested primary oocytes to complete Meiosis I to form secondary oocyte. Also, the LH surge causes the follicle to enter what is known as, Preovulatory Mature Vesicular stage.

The secondary follicle proceeds with Meiosis II, but is arrested in Metaphase approximately 3 hours before ovulation. At this time, the surface of the ovary begins to bulge locally, an avascular spot, the stigma, appears at the apex. For the oocytes to be released, two events must occur.

1. Increased collagenase activity, resulting in breakdown of collagen fibers of connective tissue surrounding the follicle
2. Increased prostaglandin levels to 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, breaks free this and floats out of the ovary. This release of the secondary oocyte from the ovarian follicle is what is known as ovulation. Some of the cumulus oophorus cells then rearrange themselves around the zona pellucida to form the corona radiata.

2. Differentiate Mitosis from Meiosis

Mitosis	Meiosis
1. It is an equational division	It is a reduction division
2. It occurs in one stage	It occurs in two stages
3. Daughter cells are similar to parents	Daughter cells differ from parents
4. Short prophase stage	Long, complicated prophase stage
5. Crossing over does not occur	Crossing over occurs
6. Chiasma formation does not occur	Chiasma formation occurs
7. Occurs in somatic cells	Occurs in sex cells

3. Discus the stages involved in fertilization

Fertilization is the union of the sperm and oocyte. It occurs within a day, through a sequence of events. The stages involved in fertilization include:

1. Passage of sperm through the corona radiata: The corona radiata is the outer most layer of the ovum. For sperms to pass through the corona radiata, they must have been capacitated. This involves the removal of the glycoprotein coat and seminal plasma proteins from the plasma membrane that overlies the acrosomal region of the spermatozoa.
2. Penetration of zona pellucida by sperm: Beneath the corona radiata, is the zona pellucida. This is a glycoprotein coat that surrounds the ovum and also induces the acrosome reaction of sperms. The acrosome of the sperm binds with the zona pellucida at one of its glycoproteins and the sperm releases acrosomal enzymes that allow sperm to penetrare the zona pellucida. 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. These enzymes prevent another sperm penetration by inactivating binding sites for spermatozoa on the zona pellucida surface
3. Fusion of plasma membrane of oocyte and sperm: The plasma or cell membranes of the oocyte and sperm then 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

4. Completion of Meiosis II by oocyte and formation of female pronucleus: The penetration of the oocyte by a sperm activates the oocyte to complete 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 female pronucleus.
5. Formation of male pronucleus: Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus. At this time, the tail of the sperm degenerates. With the two pronuclei present in the oocyte, it is now referred to as an ootid.
6. Fusion of pronuclei to form zygote: The two pronuclei of the ootid then fuse to form a zygote

4. Differentiate between Monozygotic twins and dizygotic twins

Monozygotic twins	Dizygotic twins
1. Fertilization of a single ovum	Fertilization of two separate ova
2. Similar sex	Same or different sexes
3. Identical in every way	Unlike/fraternal twins
4. Identical genetic constitution	Genetically dissimilar
5. More common	Less common
6. Placenta and chorion is fused	Placenta and chorion may be separate or fused