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COURSE: EMBRYOLOGY

ASSIGNMENT

1. Discuss ovulation.

This is the release of a secondary oocyte from the ovarian follicle. In a few days before ovulation, under the influence of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), 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 the primary oocyte to complete meiosis I 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. In the meantime, 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, two events occur which are caused by LH surge:

i) Increase in collagenase activity, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle.

ii) 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 and 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.

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.

2. Differentiate between meiosis 1 and meiosis 2.

MEIOSIS I	**MEIOSIS II**
Starts as diploid; ends as haploid.	Starts as haploid; ends as haploid.
Homologous chromosome pairs separate.	Sister chromatids separate.
Genetic recombination (crossing over) occurs.	Crossing over does not occur.
Reductive division.	Equational division.
Long duration.	Short duration.
Complicated division process.	Simple division process.
Sister chromatids in prophase have convergent arms.	Sister chromatids in prophase have divergent arms.
Prophase split into 5 sub-phases.	Prophase does not have sub-phases
Equatorial plane is centred.	Equatorial plane is rotated 90 degrees.
Ends with 2 daughter cells.	Ends with 4 daughter cells.

3. Discuss the stages involved in fertilization.

Fertilization is the union of the male (sperm) and female (oocyte) gametes to form a zygote and marks the beginning of pregnancy. Embryonic life begins with fertilization. The usual site of fertilization is the ampulla of the uterine tube. Fertilization process requires about 24 hours. It is a sequence of coordinated events which include the following stages:

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). 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 intact acrosome of the sperm binds with a zona glycoprotein (zona protein 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.

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 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 degenerates. 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. **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.

4. Differentiate between monozygotic twins and dizygotic twins.

MONOZYGOTIC TWINS	**DIZYGOTIC TWINS**
They develop from the splitting of the same fertilized egg into two.	They develop from two different eggs fertilized by two different sperm cells.
Genetic code is nearly identical.	Genetic code is like any other sibling; not identical.
Gender is always the same.	Gender is usually different.
Blood type is always the same.	Blood type may be different.

May be contained in one sac in utero.	Develop separate sacs in utero.
Appearance is extremely similar, although may not be exactly identical due to environmental factors.	Appearance is as similar as any other sibling.