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DEPARTMENT: MBBS
COURSE : EMBRYOLOGY

1. **DISCUSS OVULATION**

Ovulation is the release of secondary oocyte from the ovarian follicle. Before the occurrence of ovulation, it should be noted that the primary oocyte is surrounded by secondary/vesicular follicles. Under the influence of luteinizing hormone and Follicle stimulating hormone, the follicle matures into mature secondary follicle. This maturation coincides with the abrupt surge of luteinizing hormone production .this surge triggers ovulation-which follows the luteinizing hormone peak by 12 to 24 hours.

The luteinizing hormone surge also causes the primary oocyte to complete meiosis 1 and also causes the follicle to enter the pre ovulatory mature vesicular stage. The luteinizing hormone surge also stimulates meiosis 2. However the secondary oocyte is arrested in metaphase 2 approximately 3 hours before ovulation.

In the meantime, the surface ovary begins to bulge locally at the apex-an avascular spot. The stigma also appears. The luteinizing hormone surge elicited by the high oestrogen level in the blood causes the stigma to balloon out, forming a vesicle.

For release of oocyte, 2 events also follow the surge of luteinizing hormone. Firstly, it increases collagenase activity resulting in digestion of collagen fibres (connective tissue) surrounding the follicle. Secondly, prostaglandin level increase in response to luteinizing hormone surge and cause local muscular contractions in the ovarian wall

Now, these contractions extrude the oocyte together with its surrounding follicular (granulosa) cells from the region of the cumulus oophorous. These causes ovulation in which oocyte floats out of the ovary. Some of the cumulus oophorous cells then rearrange themselves around the zona pellucida to form corona radiate.

2. **DIFFERENTIATE B/W MEIOSIS 1 AND MEIOSIS 2**

MEIOSIS 1	**MEIOSIS 2**
- Synapsis occurs	- Synapsis does not occur
- Crossing over occurs	- Crossing over does not occur
- Formation of chiasma	- Chiasma does not form
- Involves 46 homologous duplicated chromosomes	- Involves 23 homologous duplicated chromosomes
- Reduction division of 4n to 2n	- reduction division of 2n to n
- 46 homologous duplicated chromosomes align at the equatorial plane	- 23 homologous duplicated chromosomes align at the equatorial plane
- 46 homologous duplicated chromosomes separate to opposite poles	- 23 homologous duplicated chromosomes separate to opposite poles
- Centromere does not split at disjoint	- centromere splits at disjoint
- at the end of telophase 1, formation of 2 daughter cells	- at the end of telophase 2, formation of 4 daughter cells
- 23 homologous duplicated chromosomes are formed	- 23 homologous single chromosomes are formed

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3. DISCUSS THE STAGES INVOLVED IN FERTILIZATION

a. Passage through the corona radiata
b. Penetration of zona pellucida
c. Fusion of plasma membrane of oocyte and sperm
d. Completion of meiosis 2 and formation of female pronuclei
e. Formation of male pronuclei
f. Formation of zygote

A. passage 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.

B. Penetration of 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/ 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 pellucida surface only one sperm seems to be able to penetrate the oocyte.

C. Fusion of plasma membrane of 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.

D. COMPLETION OF MEIOSIS 2 AND FORMATIONE OF FEMALE PRONUCLEI

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.

E. Formation of male pronuclei

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 (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.

F. Formation of zygote

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The chromosomes in the zygote become arranged on a cleavage spindle in preparation for cleavage of the zygote.

4. DIFFERENTIATE B/W MONOZYGOTIC TWINS AND DIZYGOTIC TWINS

MONOZYGOTIC TWINS	**DIZYGOTIC TWINS**
- Division of embryoblast	- No division of embryoblast
- They are genetically identical	- They are no genetically identical
- They look alike	- They don't look alike
- They are of the same sex	- They are of different sex
- They share the same placenta, amnion sac, chromnion sac ,	- They have separate placenta, amnion sac, chromnion sac.
- Identical twins	- Un-identical twins