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COURSE TITLE: GENERAL EMBRYOLOGY

1. DISCUSS OVULATION

Ovulation is the release of a secondary oocyte from the ovarian follicle. In the days immediately preceding ovulation, under the influence of FSH (Follicle Stimulating Hormone) and LH (Luteinizing Hormone) released by the pituitary gland, the secondary/vesicular follicle grows rapidly to a diameter of about 25mm to become a mature secondary (Graafian) follicle. Coincident with the 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 pre-ovulatory mature vesicular stage. Meiosis II is also initiated but the secondary oocyte is arrested in metaphase II approximately 3 hours before ovulation. Ovulation usually follows the LH peak by 12 to 24 hours.

In the meantime, the surface of the ovary begins bulge locally and at the apex, an avascular spot, the stigma appears. The LH surge, elicited by the high estrogen level in the blood, appears to cause the stigma to balloon out, forming a vesicle. The high concentration of LH increases collagenase activity, resulting in digestion of collagen fibres (connective tissues) surrounding the follicle. 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 breaks free and floats out of the ovary. This action of the oocyte breaking free and floating out is ovulation. Ovulation persists throughout a female's reproductive period ceases during menopause. This occurs between the ages of 48-55.

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 abdominal pain. Other signs of ovulation include;

- Tender breasts
- Swollen or tender vagina
- Change in cervical mucus
- Increased libido
- Drop in the basal body temperature, which sharply increases after ovulation

Disorders

Disorders of ovulation are classified as menstrual disorders and include oligoovulation and anovulation.

Oligoovulation is infrequent or irregular ovulation (usually defined as cycles of greater than 36 days or fewer than 8 cycles a year).

Anovulation is absence of ovulation when it would be normally expected.

2. DIFFERENTIATE BETWEEN MEIOSIS I AND MEIOSIS II

These are the differences between meiosis I and meiosis II;

MEIOSIS I	MEIOSIS II
Homologous chromosomes separate	Sister chromatids separate
Produces two diploid daughter cells	Produces four haploid daughter cells
Synapsis occurs	Synapsis absent
Crossing over occurs	Crossing over absent
Chiasma formation is present	Chiasma formation is absent
Long duration	Short duration
Reductive division	Equational division

3. DISCUSS THE STAGES INVOLVED IN FERTILIZATION

Fertilization is the union of a sperm and an oocyte to form an embryo. There are six stages involved in fertilization;

I. Passage of sperm through the corona radiata

For sperms to pass through the corona radiata, they must have been capacitated i.e. 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 freely pass 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 on the zona pellucida. Release of acrosomal enzymes (acrosine) 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. Therefore, only one sperm is to be able to penetrate the oocyte.

III. Fusion of the plasma membranes of sperm and oocyte

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 meiosis II of oocyte and the formation of the 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 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 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.

VI. Formation of the zygote

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

These are the differences between monozygotic twins and dizygotic twins;

MONOZYGOTIC TWINS	DIZYGOTIC TWINS
Twins are of the same sex	Twins are of the same or of different sex
Arise from a single zygote	Arise from two zygotes
Occurrence is more common	Occurrence is less common
Genetically identical	Genetically non-identical

Very similar physical resemblance	Resemblance like any other non-twin siblings
Mostly diamniotic, mono-chorionic with single placenta	Mostly have two amnions, two chorion and two placentas
Blood types are the same	Blood types are different