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Medicine and Surgery

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Medicine and Health Science

1) Discuss ovulation

Ovulation

This is the release of a secondary oocyte from the ovarian follicle

In a few days before ovulation, under the influence of FSH and 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, 2 events occur which are caused by LH surge:

it increases collagenase activity, resulting in digestion of collagen fibers (connective tissue) 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,

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

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.

2) Differentiate between meiosis 1 and meiosis 2

A. Meiosis I. Events that occur during meiosis I include the following:

1. Synapsis: pairing of 46 homologous duplicated chromosomes.
2. Crossing over: exchange of large segments of DNA.
3. Alignment: alignment of 46 homologous duplicated chromosomes at the metaphase plate.
4. Disjunction: separation of 46 homologous duplicated chromosomes from each other; centromeres do not split.
5. Cell division: formation of two secondary gametocytes (23 duplicated chromosomes, 2N).

B. Meiosis II. Events that occur during meiosis II include the following:

1. Synapsis: absent.

2. Crossing over: absent.
3. Alignment: alignment of 23 duplicated chromosomes at the metaphase plate.
4. Disjunction: separation of 23 duplicated chromosomes to form 23 single chromosomes; centromeres split.
5. Cell division: formation of four gametes (23 single chromosomes, 1N).

3) Discuss the stages involved in fertilization

Fertilization

This is the union of the sperm and oocyte

The usual site of fertilization is the ampulla of the uterine tube

The fertilization process takes approximately 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)

Note:

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 (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

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

Note

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

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: This occurs when one sperm fuses with one oocytes to produce a zygote which splits and forms two embryo.

1. Division takes place at the region of embryo last
2. Genetically identical
3. They look alike
4. They will have the same sex
5. They will share a common amniotic sac and chorion
6. They have different umbilical cords

WHILE

Dizygotic twins:

This occurs when two different sperms fertilize two different oocytes.

1. Genetically identical
2. They don't look alike
3. Can be different sex.
4. Amniotic sac, Chorionic sacs, Placenta and Umbilical cords are shared

