Name: Unwaetor Wisdom Samuel

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Differences between monozygotic and dizygotic twins.

Monozygotic twins	Dizygotic twins
Genetically identical	Genetically not identical
Resemblance is similar	Resemblance is just like any other two siblings
Incidence is common	Incidence is less common
Twins are of the same sex	Twins are of the same sex or different sex
Form from single zygote	Form from two zygote
Mostly diamniotic, monochorionic, with single placenta	Mostly have two amnions, two chorions, and two placentas
Are often called conjoined twins	Not seen as conjoined twins

Differences between Meiosis I and Meiosis II

Meiosis I	Meiosis II
Homologous chromosomes are present at the beginning.	Individual, bivalent chromosomes are present at the beginning.
Prophase I, metaphase I, anaphase I and telophase I are the four phases.	Prophase II, metaphase II, anaphase II and telophase II are the four phases.
Individual chromosomes are present in the daughter nuclei.	Sister chromosomes are present in the daughter nuclei.
Chromosomal cross-over occurs during prophase I.	No chromosomal cross-over occurs during prophase II.
It is a complex division, and takes more time.	It is comparatively less simple and takes less time.
It is preceded by interphase.	No interphase takes place
Cohesin protein complexes at the arms of the homologous chromosomes are cleaved.	Cohesins at the centromeres are cleaved in order to separate the two sister chromatids.
This is a heterotypic division.	This is a homotypic division
It reduces the chromosome number in the daughter cell.	It equalizes the chromosome number of both parent and daughter cells.

FERTILIZATION

Fertilization 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

Fertilization is a series of events which include the following stages:

- Passage of a sperm through the corona radiate
- Penetration of the zona pellucida
- Fusion of plasma membranes of the oocyte and sperm

- Completion of the second meiotic division of oocyte and formation of female pronucleus.
- Formation of the male pronucleus.

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)

It's important to note that only capacitated sperms can pass freely through the corona radiate.

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 the active site of 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
    - The permeability of the zona pellucida changes as soon as the head of a sperm comes in contact with the oocyte surface,
    - Lysosomal enzymes are released from cortical granules lining the plasma membrane of the oocyte when a sperm comes in contact with the oocyte surface.

    consequently, these enzymes alter properties of the zona pellucida to prevent sperm penetration, and inactivate binding sites for spermatozoa on the zona pellicida surface. That is, only one sperm seems to be able to penetrate the oocyte. Thus, preventing dispermy.

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 plasma membrane of the sperm 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

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.

Ovulation

Ovulation is defined as the release of an oocyte from the ovarian follicle.

In a few days before ovulation, under the influence of Follicle Stimulating Hormone and Luteinizing Hormone, the secondary follicle grows rapidly to a diameter of about 25 mm to become mature vesicular/mature secondary or Graafian follicle.

Contemporaneous with final development of the vesicular follicle, there is an abrupt Luteinizing Hormone surge 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. Meanwhile, 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:

I. Increase in collagenase activity, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle
II. Increase in Prostaglandin levels, resulting in 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

❖ Note:

- Ovulation is triggered by a surge of Luteinizing Hormone production
- Ovulation usually follows the Luteinizing hormone 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.

Clinical Application

- ❖ During ovulation, some women feel a variable amount of abdominal pain called mittelschmer also known as middle pain. This is 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, but there are better symptoms, such as the slight drop in basal body temperature

- ❖ Some women fail to ovulate, this is called anovulation, because of a low concentration of gonadotropins. In these cases, administration of an agent to stimulate gonadotropin release and hence ovulation can be employed.

  Although such drugs are effective, they often produce multiple ovulations, so that the risk of multiple pregnancies is 10 times higher in these women than in the general population

Corpus Luteum

Shortly after ovulation, the walls of the ovarian follicle and theca folliculi collapse and are thrown into folds. Under LH influence, they develop into a glandular structure, called corpus luteum.

Corpus luteum secretes;

1. Mainly progesterone and
2. some estrogen

Progesterone and estrogen, cause the endometrial glands to secrete and prepare the endometrium for implantation of the blastocyst. If the oocyte is fertilized, the corpus luteum enlarges to form a corpus luteum of pregnancy and increases its hormone production. The corpus luteum of pregnancy remains functionally active throughout the first 20 weeks of pregnancy

If the oocyte is not fertilized, the corpus luteum involutes and degenerates 10 to 12 days after ovulation. It is then called a corpus luteum of menstruation. Degeneration of the corpus luteum is prevented by human chorionic gonadotropin.

The corpus luteum is subsequently transformed into white scar tissue in the ovary, a corpus albicans

Except during pregnancy, ovarian cycles normally persist throughout the reproductive life of women and terminate at menopause, the permanent cessation of menstruation, usually between the ages of 48 and 55.