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QUESTIONS

1) DISCUSS OVULATION

2) DIFFERENTIATE BETWEEN MEOSIS 1 AND MEOSIS 2

3) DISCUSS THE STAGES INVOLVED IN FERTERLIZATION

4)DIFFERENTIATE BETWEEN MONOZYGOTIC TWINS AND DIZYGOTIC TWINS

1

Ovulation is the release of eggs from the ovaries. In women, this event occurs when the ovarian follicles rupture and release the secondary oocyte ovarian cells.[1] After ovulation, during the luteal phase, the egg will be available to be fertilized by sperm. In addition, the uterine lining (endometrium) is thickened to be able to receive a fertilized egg. If no conception occurs, the uterine lining as well as blood will be shed during menstruation. Ovulation occurs about midway through the menstrual cycle, after the follicular phase, and is followed by the luteal phase. Note that ovulation is characterized by a sharp spike in levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), resulting from the peak of estrogen levels during the follicular phase.

In humans, ovulation occurs about midway through the menstrual cycle, after the follicular phase. The few days surrounding ovulation (from approximately days 10 to 18 of a 28-day cycle), constitute the most fertile phase. The time from the beginning of the last menstrual period (LMP) until ovulation is, on average, 14.6 days, but with substantial variation among females and between cycles in any single female, with an overall 95% prediction interval of 8.2 to 20.5 days.

The process of ovulation is controlled by the hypothalamus of the brain and through the release of hormones secreted in the anterior lobe of the pituitary gland, luteinizing hormone (LH) and follicle-stimulating hormone (FSH) In the preovulatory phase of the menstrual cycle, the ovarian follicle will undergo a series of transformations called cumulus expansion, which is stimulated by FSH. After this is done, a hole called the stigma will form in the follicle, and the secondary oocyte will leave the follicle through this hole. Ovulation is triggered by a spike in the amount of FSH and LH released from the pituitary gland. During the luteal (post-ovulatory) phase, the secondary oocyte will travel through the fallopian tubes toward the uterus. If fertilized by a sperm, the fertilized secondary oocyte or ovum may implant there 6–12 days later

Follicular phase The follicular phase (or proliferative phase) is the phase of the menstrual cycle during which the ovarian follicles mature. The follicular phase lasts from the beginning of menstruation to the start of ovulation

For ovulation to be successful, the ovum must be supported by the corona radiata and cumulus oophorous granulosa cells. The latter undergo a period of proliferation and mucification known as cumulus expansion.

An increase in cumulus cell number causes a concomitant increase in antrum fluid volume that can swell the follicle to over 20 mm in diameter. It forms a pronounced bulge at the surface of the ovary called the blister.

Ovulation

Estrogen levels peak towards the end of the follicular phase. This, by positive feedback, causes a surge in levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH). This lasts from 24 to 36 hours, and results in the rupture of the ovarian follicles, causing the oocyte to be released from the ovary.

It is forming a hole called the *stigma*. By this time, the oocyte has completed meiosis I, yielding two cells: the larger secondary oocyte that contains all of the cytoplasmic material and a smaller, inactive first polar body. Meiosis II follows at once but will be arrested in the metaphase and will so remain until fertilization. The spindle apparatus of the second meiotic division appears at the time of ovulation. If no fertilization occurs, the oocyte will degenerate between 12 and 24 hours after ovulation. Approximately 1-2% of ovulations release more than one oocyte. This tendency increases with maternal age. Fertilization of two different oocytes by two different spermatozoa results in fraternal twins. The mucous membrane of the uterus, termed the functionalis, has reached its maximum size, and so have the endometrial glands, although they are still non-secretory.

Luteal phase

The follicle proper has met the end of its lifespan. Without the oocyte, the follicle folds inward on itself, transforming into the corpus luteum (pl. corpora lutea), a steroidogenic cluster of cells that produces estrogen and progesterone. These hormones induce the endometrial glands to begin production of the proliferative endometrium and later into secretory endometrium, the site of embryonic growth if implantation occurs.

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 (in a post-menarchal, premenopausal female). Anovulation usually manifests itself as irregularity of menstrual periods, that is, unpredictable variability of intervals, duration, or bleeding. Anovulation can also cause cessation of periods (secondary amenorrhea) or excessive bleeding (dysfunctional uterine bleeding).

2

1. Length of Prophase

- **Mitosis:** During the first mitotic stage, known as prophase, chromatin condenses into discrete chromosomes, the nuclear envelope breaks down, and spindle fibers form at opposite poles of the cell. A cell spends less time in prophase of mitosis than a cell in prophase I of meiosis.
- **Meiosis:** Prophase I consist of five stages and lasts longer than prophase of mitosis. These five stages do not occur in mitosis. Genetic recombination and crossing over take place during prophase I.

2. Tetrad Formation

- **Mitosis:** Tetrad formation does not occur.
- **Meiosis:** In prophase I, pairs of homologous chromosomes line up closely together forming what is called a tetrad. A tetrad consists of four chromatids (two sets of sister chromatids).

3. Genetic Composition

- **Mitosis:** The resulting daughter cells in mitosis are genetic clones (they are genetically identical). No recombination or crossing over occur.
- **Meiosis:** The resulting daughter cells contain different combinations of genes. Genetic recombination occurs as a result of the random segregation

of homologous chromosomes into different cells and by the process of crossing over (transfer of genes between homologous chromosomes).

4. Daughter Cell Number

- **Mitosis:** Two daughter cells are produced. Each cell is diploid containing the same number of chromosomes.
- **Meiosis**: Four daughter cells are produced. Each cell is haploid containing one-half the number of chromosomes as the original cell.

5. Chromosome Alignment in Metaphase

- **Mitosis:** Sister Chromatids (duplicated chromosome comprised of two identical chromosomes connected at the centromere region) align at the metaphase plate (a plane that is equally distant from the two cell poles).
- **Meiosis:** Tetrads (homologous chromosome pairs) align at the metaphase plate in metaphase I.

6. Chromosome Separation

- **Mitosis:** During anaphase, sister chromatids separate and begin migrating centromere first toward opposite poles of the cell. A separated sister chromatid becomes known as daughter chromosome and is considered a full chromosome.
- **Meiosis:** Homologous chromosomes migrate toward opposite poles of the cell during anaphase I. Sister chromatids do not separate in anaphase I.

7. Cell Division

- **Mitosis:** A somatic cell divides once. Cytokinesis (the division of the cytoplasm) occurs at the end of telophase.
- **Meiosis:** A reproductive cell divides twice**.** Cytokinesis happens at the end of telophase I and telophase II.

Human fertilization is defined as the union between egg and sperm cells to cause a pregnancy.Fertilization is defined as the fusion between the male and female gametes, that is, sperm and egg, thereby reestablishing the normal number of chromosomes in humans (46 chromosomes).

For human fertilization to be possible, it is necessary that a man ejaculates inside the vagina of a woman. From that moment on, spermatozoa will start their journey inside the female reproductive tract until they reach the Fallopian tubes, where the egg cell is located.

Stages of natural fertilization

Passage of sperm through the corona radiata

The first stage of human fertilization is the penetration of spermatozoa into the corona radiata of the egg, a coat made of cells that surrounds the egg.

Sperm cells are able to go through this first barrier thanks to the release of the hyaluronidase enzyme, and the motion of their flagellum (the tail).

Penetration of the corona radiata

When they cross this layer, spermatozoa encounter a second barrier: the zona pellucida (ZP). It is an external layer that surrounds oocytes.

Penetration of the zona pellucida

More than a single sperm cell is required to degrade the ZP. Nonetheless, in the end just one of them will be the "winner", that is, the one who fertilizes the egg.

In order to be able to cross this second barrier, the head of the sperm establishes contact with receptor ZP3 of the ZP. This triggers the acrosome reaction, which involves the release of a series of hydrolytic enzymes (contents of the acrosome). These enzymes dissolve the ZP to allow the passage of the sperm cell.

The acrosome reaction causes a series of modifications of the sperm cell that allow its natural capacitation. Sperm capacitation, at the same time, allows it to get into the cell egg, causing the membranes of both reproductive cells to fuse together.

Fusion of the plasma membranes of the sperm and oocyte

When the egg cell makes it to the plasma membrane of the oocyte, it triggers three different processes in the female gamete:

Formation of the fertilization cone

Instant depolarization of the egg membrane

Release of cortical granules from the egg

The formation of the fertilization cone enables fusion between the membranes of both the egg and the sperm, allowing passage of the sperm's head into the egg. Simultaneously, thanks to depolarization and the release of cortical granules, the entrance of multiple sperm is prevented.

Formation of the male pro nucleus

Now that the passage of sperm has taken place, the oocyte activates itself to finish meiosis, the process whereby the number of chromosomes is reduced. With it, the second polar body is released, and chromosomes distribute themselves forming a structure called female pronucleus.

Pronuclei are the nuclei of gametes, which have the particularity of having half the chromosomes in comparison to the remainder of cells in the body, that is, 23 chromosomes.

On the other hand, the sperm continues the fertilization process until its head, which contains the nucleus, reaches the female pronucleus. The sperm will lose its tail at some point, and the nucleus will swell to create the male pronucleus.

When both pronuclei are next to each other, fusion occurs.

The fusion of pronuclei means that the membranes of both end up disappearing so that the chromosomes can fuse together. This allows the cell to reestablish its normal number of chromosomes, that is, 46 chromosomes.

Formation of zygote

The fertilization process of humans culminates with the formation of the zygote: the first cell of the organism, created after egg and sperm fuse into one.

In addition to all this, fertilization determines the gender of the baby-to-be based on sex chromosomes:

Male zygote

sex chromosomes are XY, so the unborn child is a boy.

Female zygote

sex chromosomes are XX, so the unborn child is a girl.

Egg cells always carry an X-chromosome. Thus, the sex of embryos is determined by the sperm, which can carry either an X or Y chromosome.

This is the entire human fertilization process step by step. However, you can see a diagram of the complete process summarized below:

4.

Development

Monozygotic Twins: Monozygotic twins are developed by the splitting of a fertilized embryo into two.

Dizygotic Twins: twins are developed by two separate fertilization events occurring at the same time.

Causes

Monozygotic Twins: The cause for monozygotic twins is not known.

Dizygotic Twins: twins are caused either by IVF, certain fertility drugs or hereditary predisposition due to the hyper-ovulation.

Called as

Monozygotic Twins: Monozygotic twins are called identical twins.

Dizygotic Twins: twins are called fraternal twins.

Genetic Code

Monozygotic Twins: The genetic codes of the monozygotic twins are nearly identical.

Dizygotic twins: completely different genetic profile.

SEX

Monozygotic twins: always the same sex

Dizygotic twins : maybe of the same sex or not