AFE BABALOLA UNIVERSITY

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DEPARTMENT:

MEDICINE AND SURGERY (MBBS)

COURSE :

Embryology

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QUESTIONS

1. Discuss Ovulation
2. Differentiate between meiosis 1 and meiosis 2
3. Discuss the stages involved in fertilization
4. Differentiate between monozygotic twins and dizygotic twins.

Ovulation

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. 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.

The following factors may lead to ovulation:

• Ovulation occurs due to high concentration of luteinizing hormones (LH) in blood just before ovulation.
• A high concentration of LH leads to increase activity of the enzyme collagenase, which in turn digests the collagen fibers surrounding the follicle.
• Increase in concentration of *prostaglandins* causes contraction of smooth muscle in the wall of the ovary.
• The increased pressure of fluid in the follicular cavity is also a significant factor for ovulation to occur.
• However, the enzymatic digestion of the follicular wall seems to be the main factor responsible for ovulation.

Process

Around the middle of the ovarian cycle, the ovarian follicle, under the influence of FSH and LH, undergoes a sudden growth spurt, producing a cystic swelling or bulge on the surface of the ovary. A small avascular spot, the stigma soon appears on the swelling.
Before ovulation, the secondary oocyte and some cells of the cumulus oophorus detach from the interior of the distended follicle.
Ovulation is triggered by a surge of LH production. Ovulation usually follows the LH peak by 12-24hours. The LH surge, elicited by the high estrogen level in the blood, appears to cause the stigma to balloon out forming a vesicle. The stigma soon ruptures, expelling he secondary oocyte with the follicular fluid. Expulsion of the oocyte is the result of intrafollicuar pressure, and possibly by contraction of smooth muscle in the theca externa (sheath) owing to stimulation by prostaglandins.
The expelled secondary oocyte is surrounded by the zona pellucida and one or more layers of follicular cells, which are radially arranged as the corona radiata forming the oocyte-cumulus complex. The LH surge also seems to induce resumption of the first meiotic division of the primary oocyte. Hence, mature ovarian follicles contain secondary oocytes. The zona pellucida is composed of here glycoproteins (ZPA, ZPB and ZPC), which usually form a network of

filaments with multiple pores. Binding of the sperm to the zona pellucida (sperm-oocyte interactions) is a complex and critical event during fertilization.

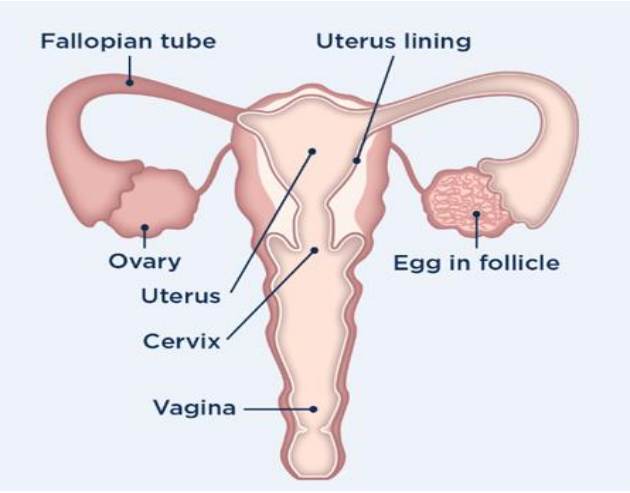
Conditions affecting ovulation:

- **Age:** Anovulatory cycles are common before puberty, initial cycles after puberty, after menopause.
- Pregnancy
- Lactation
- Diseases—nutritional, endocrine and emotional
- Environment—extremes of temperature.

Clinical correlates-

Mittelschmerz and ovulation- A variable amount of abdominal pain, mittelschmerz accompanies ovulation in some women. 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 secondary indicator of ovulation, but there are better primary indicators, such as elevation of basal body temperature

Anovulation- Some women do not ovulate because of inadequate release of gonadotropins. In some of these women, ovulation can be induced by the administration of gonadotropins or an ovulatory agent such as clomiphene citrate. This drug stimulates the release of pituitary gonadotropins (FSH and LH), resulting in maturation of several ovarian follicles and multiple ovulations



Differentiate between meiosis 1 and meiosis 2

Meiosis-

Is a process where a single cell divides twice to produce four cells containing half the original amount of genetic information. These cells are our sex cells- sperm in males, eggs in females.

S/N	Meiosis 1	Meiosis 2
1	Meiosis 1 is a heterotypic division	Meiosis 2 is homotypic division
2	Reduces the chromosome number in the daughter cell	Equalizes the chromosome number of both parent and daughter cells
3	Preceded by interphase	No interphase takes places
4	A complex division and takes more time	Comparatively less simple and takes less time
5	Individual chromosomes are present in the daughter nuclei	Sister chromosomes are present in the daughter nuclei
6	Chromosomal crossover occurs during prophase 1	No chromosomal cross-over occurs during prophase 2
7	Prophase 1,metaphase 1,anaphase 1, and telophase1 are the four phases	Prophase 2, metaphase 2, anaphase 2, and telophase2 are the four phases
8	Homologous chromosomes are present at the beginning	Individual, bivalent chromosomes are present at the beginning

Stages involved in fertilization

Human fertilization- Is the union of a human egg and sperm, usually occurring the ampulla of the fallopian tube. The result of this union is the production of a zygote cell or fertilized egg, initiating prenatal development.

The usual site of fertilization is the ampulla of the uterine tube, its longest and widest part. If the oocyte is not fertilized here, it slowly passes along the tube to the uterus, where it degenerates and is resorbed. Although fertilization may occur in other parts of the tube, it does not occur in the uterus. Chemical signals (attractants), secreted by the oocyte and surrounding follicular cells, guide the capacitated sperms (sperm chemo taxis) to the oocyte.
Fertilization is a complex sequence of coordinated molecular events that begins with contact between a sperm and an oocyte and ends with the intermingling of

maternal and paternal chromosomes at metaphase of the first mitotic division of the zygote, a unicellular embryo. Defects at any stage in the sequence of these events might cause the zygote to die. The fertilization process takes approximately 24 hours.

Phases of Fertilization

Fertilization is a sequence of coordinated events -

1. Passage of a sperm through the corona radiata. Dispersal of the follicular cells of the corona radiata surrounding the oocyte and zona pellucida appears to result mainly from the action of the enzyme hyaluronidase released from the acrosome of the sperm, but the evidence of this is not unequivocal. Tubal mucosal enzymes also appear to assist the dispersal. Movements of the tail of the sperm are also important in its penetration of the corona radiata.

2. Penetration of the zona pellucida. Passage of a sperm through the zona pellucida is the important phase in the initiation of fertilization. Formation of a pathway also results from the action of enzymes released from the acrosome. The enzymes esterases, acrosin, and neuraminidase appear to cause lysis of the zona pellucida, thereby forming a path for the sperm to follow to the oocyte. The most important of these enzymes is acrosin**,** a proteolytic enzyme. Once the sperm penetrates the zona pellucida, a zona reaction-a change in the properties of the zona pellucida-occurs that makes it impermeable to other sperms. The composition of this extracellular glycoprotein coat changes after fertilization. The zona reaction is believed to result from the action of lysosomal enzymes released by cortical granules near the plasma membrane of the oocyte. The contents of these granules, which are released into the perivitelline space, also cause changes in the plasma membrane that make it impermeable to other sperms.

3. 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.

4. 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. Following decondensation of the maternal chromosomes, the nucleus of the mature oocyte becomes the female pronucleus.

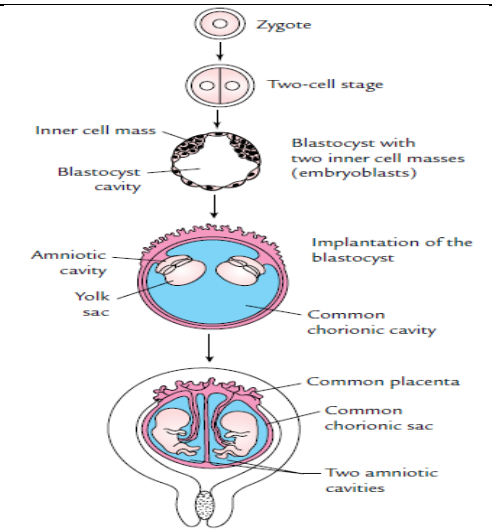
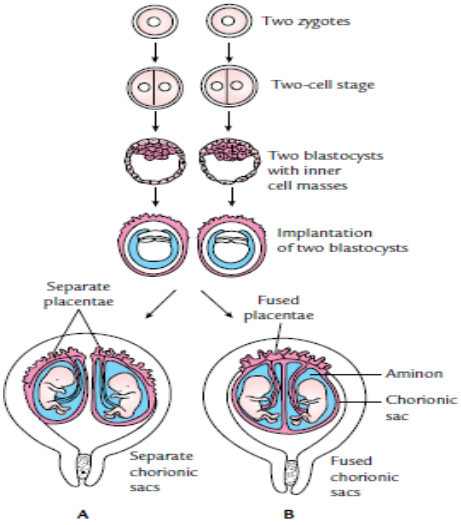
5. Formation of the male pronucleus. Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus and the tail of the sperm degenerates. Morphologically, the male and female pronuclei are indistinguishable. The oocyte containing two haploid pronuclei is called an ootid.

6. As the 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

Differentiate between monozygotic twins and dizygotic twins.

Twins are two offspring produced by the same pregnancy. Twins can be either monozygotic (identical), meaning that they develop from one zygote which splits and form two embryos, or dizygotic (non-identical or fraternal), meaning that each twin develops form a separate egg and each egg is fertilized by its own sperm cell

S/N	Monozygotic twins	Dizygotic twins
1	Monozygotic twins are developed by the splitting of a fertilized embryo into two	Dizygotic twins are developed by two separate simultaneous fertilization events.
2	Cause is not known	Caused either by IVF, certain fertility drugs or hereditary predisposition
3	Shared placentas	Separate placentas
4	Genetic codes are nearly identical	Genetic codes are same as any other sibling
5	Gender is the same	Gender is different
6	Blood types are the same	Blood types are different
7	Appearance is extremely similar but may be affected by environmental factors	Appearance is similar as any other siblings

8	One third of the world population are monozygotic	Two-thirds of the twins in the world are dizygotic
9	 Monozygotic twins.	 Dizygotic twins.

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