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Question

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

1. OVULATION

The release of the ovum/ova **(secondary oocyte)** from the ovary is called ovulation. The ovarian follicle is at first very small compared to the thickness of the cortex of the ovary. As it enlarges the mature Graafian follicle, becomes so big that it not only reaches the surface of the ovary, but also forms a bulging in this situation. As a result of this, the follicle ruptures and the ovum are released from the ovary. Just before ovulation the follicle may have a diameter of 15 mm. The stroma and theca on this side of the follicle become very thin. An avascular spot **(stigma)** appears over the as the ovary bulges out. At the same time, the cells of the cumulus oophorus become loosened by accumulation of intercellular fluid between them. During the ovulation process there is rupture of mature follicle and release of secondary oocyte in metaphase of 2nd meiotic division.
At ovulation the secondary oocyte is released from the surface of the ovary into the pelvic cavity together with first polar body and corona radiata cells. The ovulated oocyte with its surrounding cells swims toward the fimbrial end of fallopian tube. In the ampulla of fallopian tube several sperms surround the secondary oocyte with its enclosed cells of the carona radiata . One sperm penetrates the various barriers surrounding the secondary oocyte. This initiates resuming of meiosis II of secondary oocyte. Completion of meiosis I results in secondary oocyte and the first polar body

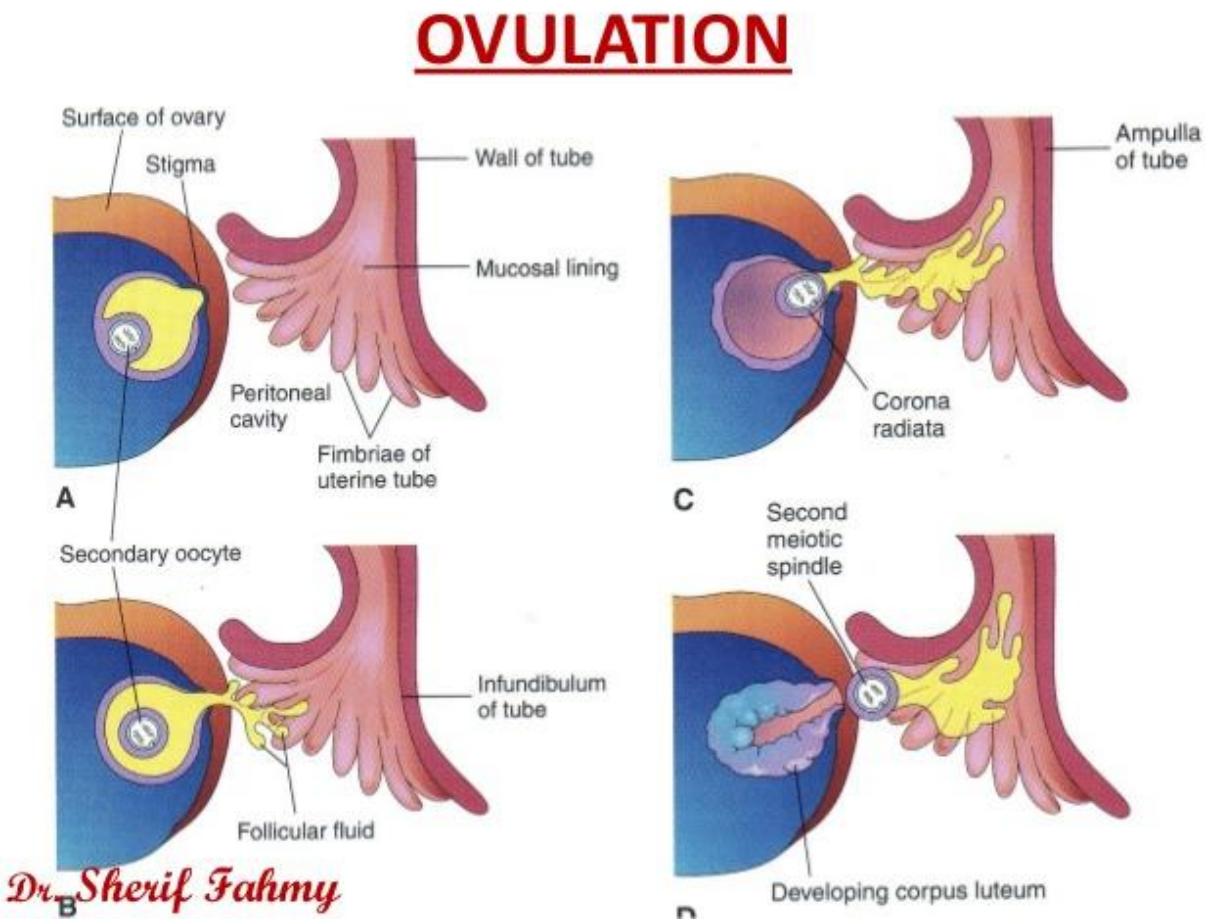
CLINICAL APPLICATION

Detection of time of ovulation: Basal body temperature recording it falls between 0.3–0.5°C just before ovulation and increases slightly thereafter. Time of ovulation can be determined by recording the morning
temperature during mid-cycle.
Endometrial biopsy: to observe changes specific for ovulation under the influence of progesterone
Observation of cervical mucus*:* It is sticky and presents fern pattern.

Hormonal estimation: Blood progesterone, estrogen, FSH, LH estimation during mid-cycle—Increased LH and estrogen and decreased FSH at the time of ovulation and increased progesterone after ovulation.

Ultrasonography: process of ovulation can be recorded. Corpus
luteum detection in ovary.
Uterine bleeding—Intermenstrual occurs.
Vaginal smear—Increased cornification of mucosa.

Mittleschmerz—mid-cycle pain
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.



2. DIFFERENCES BETWEEN MEIOSIS I AND MEIOSIS II

MEIOSIS I	MEIOSIS II
In meiosis I, homologous duplicated chromosomes separate.	In meiosis II, sister chromatids separate.
Meiosis I produces 2 diploid daughter cells.	Meiosis II produces 4 haploid daughter cells,
Synapsis, genetic recombination (crossing over), chiasma formation only occurs in meiosis I	Genetic recombination (crossing over) , no synapsis and no chiasma formation occurs.

FERTILIZATION

Fertilization involves the process of fusion of two highly mature haploid germ cells, an ovum and a sperm resulting in the formation of a diploid mononucleated single cell, the zygote. The process occurs usually in the ampulla of the female uterine tube. The process of human fertilization is very complicated and comprises of many components and steps. Both male and female gametes have to complete a number of biological processes prior to actual process of fertilization. The stages are:

3. STAGES INVOLVED IN FERTILIZATION

1. Passage of the sperm through corona radiata surrounding the zona pellucida of an oocyte.
2. Penetration of the zona pellucida surrounding the oocyte.
3. Fusssion of the plasma membranes of the oocyte and the sperm;
4. Completion of the second meiotic division of oocyte and formation of female pronucleaus.
5. Formation of male pronucleus
6. The 2 pronuclei fuse into a single diploid aggregation of chromosomes, the ootid becomes a zygote

1.Passage of the sperm through corona radiata surrounding the zona pellucida of an oocyte.

Sperms can only pass through the corona radiate when they 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 pass freely through the corona radiata

2. Penetration of the zona pellucida surrounding the oocyte.

The zona pellucida is a shell like glycoprotein 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. The release of some 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 oocyteIn turn, these enzymes alter properties of the zona pellucida to :prevent sperm penetration and inactivate binding sites for spermatozoa on the zona pellicida surface only one sperm seems to be able to penetrate the oocyte.

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: When the sperm penetrates the body, it 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

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.

6.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. DIFFERENCES BETWEEN MONOZYGOTIC TWINS AND DIZYGOTIC TWINS

MONOZYGOTIC TWINS	DIZYGOTIC TWINS
Monozygotic twins are formed by one sperm and one egg.	Dizygotic twins are formed by two different sperm and two different eggs.
They are genetically identical. They look alike and are of the same sex.	They are genetically un-identical, they don't look alike. They could be of the same sex or different sexes.
They share the same amniotic sac, same chorion and placenta.	They do not share the same amniotic sac, same chorion and placenta.