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COURSE: EMBRYOLOGY

1. DISCUSS OVULATION

Ovulation is when a mature egg is released from the ovary, pushed down the fallopian tube, and is made available to be fertilized. Approximately every month an egg will mature within one of your ovaries. As it reaches maturity, the egg is released by the ovary where it enters the fallopian tube to make its way towards waiting for sperm and the uterus. The lining of the uterus has thickened to prepare for the fertilized egg. If no conception occurs, the uterine lining, as well as blood, will be shed. The shedding of an unfertilized egg and the uterine wall is the time of menstruation.

It has the following stages:

i. Follicular stage

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. Mucification is the secretion of a hyaluronic acid-rich cocktail that disperses and gathers the cumulus cell network in a sticky matrix around the ovum. This network stays with the ovum after ovulation and has been shown to be necessary for fertilization. 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

ii. Ovulation

Oestrogen 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. Through a signal transduction cascade initiated by LH, proteolytic enzymes are secreted by the follicle that degrade the follicular tissue at the site of the blister, forming a hole called the *stigma*. The secondary oocyte leaves the ruptured follicle and moves out into the peritoneal cavity through the stigma, where it is caught by the fimbriae at the end of the fallopian tube. After entering the fallopian tube, the oocyte is pushed along by cilia, beginning its journey toward the uterus. 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

iii. 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 oestrogen 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. The action of progesterone increases basal body temperature by one-quarter to one-half degree Celsius (one-half to one

degree Fahrenheit). The corpus luteum continues this paracrine action for the remainder of the menstrual cycle, maintaining the endometrium, before disintegrating into scar tissue during menses.

2. Differentiate between meosis 1 and meosis 2

MEOSIS I	MEOSIS II
1. There is crossing over and synapsis	There is no synapsis and crossing over.
2. Centromeres do not split	Centromeres split
3. There is formation of chaisma	No formation of chiasma
4. Involves 46 duplicated homologous chromosomes	Involves 23 duplicated homologous chromosomes
5. 2 daughter cells are formed	4 daughter cells are formed
6. No spindle fibres	Spindle fibres form

3. Discuss the stages involved in ferterlization

i. Passage of sperm through the corona radiata

For sperm to pass through the corona radiata, the sperm must first lose its glycoprotein coat and seminal plasma proteins in a process called capacitation.

ii. Penetration of the zona pellucida

The zona pellucida is a glycoprotein shell which is found around the ovum, in order for the sperm to pass through it, the acrosomal enzymes in the head of the sperm dissolves this barrier. As this goes on, the egg releases some lysosomal

enzymes to prevent penetration of another sperm cell and inactivate spermatozoa binding sites.

iii. Fusion of plasma membranes of sperm and egg

The plasma membranes of the sperm and egg then fuse allowing only the head and tail of the sperm to move through the cytoplasm

iv. Formation of female pronucleus

The oocyte then undergoes 2nd meotic division as the sperm penetrates and forms the female pronucleus (nucleus of mature ovum) and 2nd polar body.

v. Formation of male pronucleus

Inside the cytoplasm of the oocyte, the head of the sperm cell enlarges to form the male pronucleus and the tail degenerates.

vi. Formation of zygote

The male and female pronuclei (each containing 23 chromosomes) then fuse in the ampulla of the fallopian tube to form the zygote.

4. Differentiate between monozygotic twins and dizygotic twins

Monozygotic	Dizygotic
i. Formed by the same spermatozoa and egg	Formed by different spermatozoa and egg
ii. Twins are identical and same sex	Twins are non-identical and can be different sexes
iii. Placenta is fused	Placenta may be fused or separate
iv. Genetically similar	Genetically unidentical
v. Blastocyst differentiates into two after zygote is formed	Division continues normally in each oocyte to form different zygotes and blastocysts