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200L

1)DISCUSS OVULATION

2)DIFFERENTIATE BETWEEN MEIOSIS 1 AND MEIOSIS 2

3)DISCUSS THE STAGES TAKEN IN FERTILISATION

4)DIFFERENTIATE BETWEEN MONOZYGOTIC TWINS AND DIZYGOTIC TWINS

5)DISCUSS THE SECOND WEEK OF DEVELOPMENT.

**OVULATION**

This is the release of a secondary oocyte from the ovarian follicle.In a few days before ovulation, under the influence of FSH(FOLLICLE STIMULATING HORMONE) and LH(LUTEINIZING HORMONE),the secondary follicle grows rapidly to a diameter of about 25mm to become mature vesicular/ mature secondary or Graafianfollicle.

Coincident with final development of the vesicular follicle, there is an abrupt increase in LH that causes;

1)the primary oocyte to complete meiosis I

2)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.In the meantime, 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:

1)it increases collagenase activity, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle

2)Prostaglandin levels also increase in response to the LH surge and cause local muscular contractions in the ovarian wall. Those contractions extrude the oocyte, which together with its 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:

1)Ovulation is triggered by a surge of LH production

2)Ovulation usually follows the LH peak by 12 to 24 hours

3)The LH surge, elicited by the high estrogen level in the blood,

appears to cause the stigma to balloon out, forming a vesicle.

**DIFFERENCES BETWEEN MEIOSIS 1 AND MEIOSIS 2**

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| MEIOSIS 1 | MEIOSIS 2 |
| 1)Synapsis occurs  2)Crossing over occurs  3)Chiasma formation occurs  4)Centromeres do not split  5)There is an alignment of the 46 homologous duplicated chromosome at the metaphase plate  6)Formation of 2 secondary gametocytes(23 duplicated chromosome 2N) | 1)Synapsis does not occur  2)Crossing over does not occur  3)Chiasma formation does not occur  4)Centromeres split  5)Alignment of 23 duplicated chromosomes  6)Formation of 4 secondary gametocytes(23 single chromosomes 1N) |

**STAGES TAKEN IN FERTILIZATION** ;

This 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,It is a sequence of coordinated events which include the following stages;

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 plasmaproteins from the plasma membrane that overlies the acrosomal region of the spermatozoa).

Note:Only capacitated sperms can pass freely through the corona radiata

2)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 a zonaglycoprotein (ZP3/ zona protein 3) on 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. 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 oocyte. In turn, these enzymes alter properties of the zona pellucida to :

\*)prevent sperm penetration and

\*)inactivate binding sites for spermatozoa on the zona pellucida surface .Only one sperm seems to be able to penetrate the oocyte

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 sperm's plasma membrane remains behind

IV. . Completion of the second meiotic division of oocyte and formation of female pronucleu**s**

* 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

1. 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

1. 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

**DIFFERENCES BETWEEN MONOZYGOTIC TWINS AND DIZYGOTIC TWINS**

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| --- | --- |
| MONOZYGOTIC TWIN | DIZYGOTIC TWIN |
| 1 Twins can be monozygotic ("identical"), meaning that they develop from one zygote, which splits and forms two embryos  2) Because fraternal, or dizygotic, twins are 2 separate fertilized eggs, they usually develop 2 separate amniotic sacs, placentas, and supporting structures.  3) Monozygotic twins have exactly identical DNA  4)Blood types are the same  5)Gender is the same  6)Cause is not known | 2)Twins can be dizygotic ("fraternal"), meaning that each twin develops from a separate egg and each egg is fertilized by its own sperm cell.  2) . Identical, or monozygotic, twins may or may not share the same amniotic sac, depending on how early the single fertilized egg divides into 2.  3) dizygotic twins do not have identical DNA.  4)Blood types are different  5)Gender is different  6)Caused either by IVF certain fertility drugs, or hereditary predisposition |

**2nd WEEK OF DEVELOPMENT**

The following events take place during the 2nd week of development:

1. Completion of implantation of the blastocyst
2. Formation of bilaminar embryonic disc(epiblast and hypoblast)
3. Formation of extraembryonic structures(amniotic cavity, amnion, umbilical vesicle [yolk sac], connecting stalk, and chorionic sac)

Day 8

* At the eighth day of development, the blastocyst is partially (slowly) embedded in the endometrium
* the syncytiotrophoblast continues its invasion of the endometrium, thereby eroding endometrial blood vessels and endometrial glands
* More cells in the cytotrophoblast divide and migrate into the syncytiotrophoblast, where they fuse and lose their individual cell membranes
* Cells of the inner cell mass or embryoblast also differentiate into 2 layers:

1. the hypoblast layer, which is made up of small cuboidal cells, and it is adjacent(nearer) to the blastocyst cavity
2. the epiblast layer which is made up of high columnar cells, and it adjacent to the amniotic cavity

* The hypoblast and epiblast layers together form a flat ovoid shaped disc called the bilaminar embryonic disc
* At the same time, a small cavity appears within the epiblast which enlarges to form the amniotic cavity
* Epiblast cells adjacent to the cytotrophoblast are called amnioblasts
* Amnioblasts together with the rest of the epiblast, line the amniotic cavity

The endometrium adjacent to the implantation site is edematous and highly vascular

Day 9

* The blastocyst is more deeply embedded in the endometrium, and the penetration defect in the surface epithelium is closed by a coagulum called fibrin
* Vacuoles appear at the region of the trophoblast and they fuse to form lager lacunae
* this phase of trophoblast development is known as the lacunar stage
* the cells of the hypoblast adjacent to the cytotrophoblast form a thin membrane called the exocoelomic (Heuser’s) membrane
* this membrane lines the inner surface of the cytotrophoblast
* the exocoelomic (Heuser’s) membrane together with the hypoblast forms the lining of the exocoelomic cavity, or primitive yolk sac or primary umbilical vesicle

11-12th

* The blastocyst is completely embedded in the endometrium,
* and the surface epithelium almost entirely covers the original defect in the uterine wall
* The blastocyst now produces a slight protrusion into the lumen of the uterus
* cells of the syncytiotrophoblast penetrate deeper into the stroma(tissue) and erode the endothelial lining of the endometrial capillaries
* These ruptured endometrial capillaries are called sinusoids
* The lacunae then begin to communicate with the sinusoids, and maternal blood enters the lacunar system
* The communication of the eroded endometrial capillaries with the lacunae establishes the primordial uteroplacental circulation
* When maternal blood flows into the lacunae, oxygen and nutritive substances are available to the embryo
* . a new population of cells appears between the inner surface of the cytotrophoblast and the outer surface of the exocoelomic cavity
* These cells which are derived from yolk sac cells form a fine, loose connective tissue called the extraembryonic mesoderm
* Soon, large cavities develop in the extraembryonic mesoderm, and when these become confluent, they form a new space known as the extraembryonic cavity, or chorionic cavity or extraembryonic coelom
* This space surrounds the primitive yolk sac and amniotic cavity, except where the germ disc is connected to the trophoblast by the connecting stalk (which develops into the umbilical cord)
* The extraembryonic mesoderm lining the cytotrophoblast and amnion is called the extraembryonic somatic mesoderm
* extraembryonic somatic mesoderm also forms the connecting stalk
* the lining covering the yolk sac is known as the extraembryonic splanchnic mesoderm

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* As the conceptus implants, the endometrial connective tissue cells undergo a transformation, called decidual reaction
* During this transformation, the cells of the endometrium swell because of the accumulation of glycogen and lipid in their cytoplasm, and they are known as decidual cells
* The primary function of the decidual reaction is to provide nutrition for the early embryo and an immunologically privileged site for the conceptus

13th day of development

* The surface defect in the endometrium has been completely covered by the surface epithelium
* Occasionally bleeding occurs at the implantation site as a result of increased blood flow into the lacunar spaces
* . Cells of the cytotrophoblast proliferate locally and penetrate into the syncytiotrophoblast, forming cellular columns surrounded by syncytium
* Cellular columns with the syncytial covering are known as primary villi
* The primary yolk sac becomes reduced in size and is known as the secondary yolk sac
* This new cavity is known as the secondary yolk sac or definitive yolk sac or the secondary umbilical vesicle
* In humans the yolk sac contains no yolk but is important for the transfer of nutrients between the fetus and mother
* This yolk sac is much smaller than the original exocoelomic cavity or primitive yolk sac
* During its formation, large portions of the exocoelomic cavity are pinched off to form exocoelomic cysts
* . Exocoelomic cysts are often found in the extraembryonic cavity or chorionic cavity or extraembryonic coelom
* Meanwhile, the extraembryonic coelom expands and forms a large cavity called the chorionic cavity
* The extraembryonic mesoderm lining the inside of the cytotrophoblast is then known as the chorionic plate
* The only place where extraembryonic mesoderm traverses the chorionic cavity is in the connecting stalk
* With development of blood vessels, the connecting stalk becomes the umbilical cord

Clinical correlate

* The syncytiotrophoblast produces a hormone called the human chorionic gonadotrophin (hCG), which enters the maternal blood via lacunae keeps the corpus luteum secreting estrogens and progesterone
* hCG maintains the hormonal activity of the corpus luteum in the ovary during pregnancy
* hCG can be detected in maternal blood or urine as early as day 10 of pregnancy and is the basis for pregnancy tests
* Enough hCG is produced by the syncytiotrophoblast at the end of the second week to give a positive pregnancy test, even though the woman is probably unaware that she is pregnant

Extrauterine Implantation

* Blastocysts may implant outside the uterus
* These implantations result in ectopic pregnancies
* 95% to 98% of ectopic implantations occur in the uterine tubes, most often in the ampulla and isthmus .