



Embryology

Faculty of Medicine – JU2017

☒ Sheet

☐ Slides

Number

5

Done by:

Marah Bitar

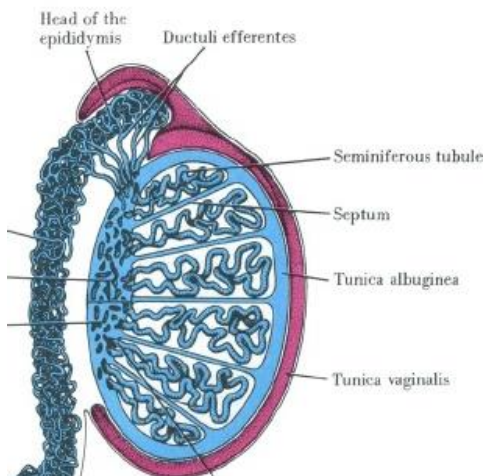
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Yahya Salem

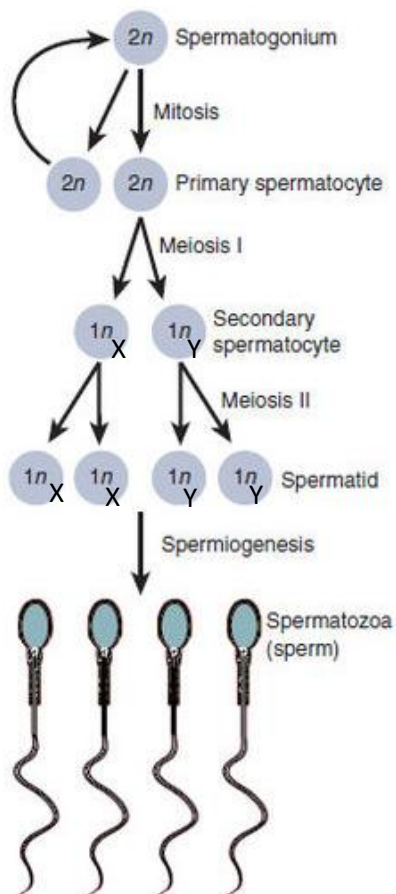
Doctor

Maher Al-hadidi

Sperm development occurs in two stages in the seminiferous tubules of the testes (each is 70 cm in length)



(a) Spermatogenesis



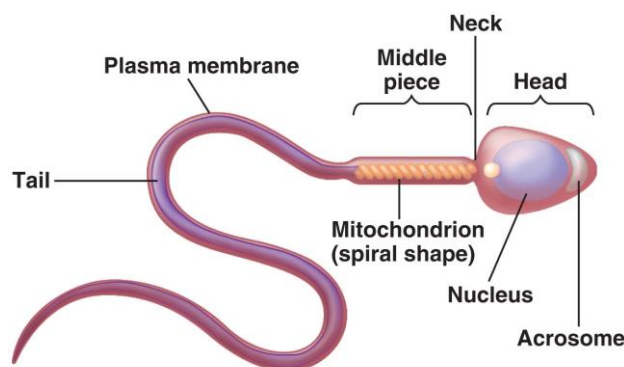
1- Spermatogenesis (starts at puberty)

- Spermatogonia (46 XY) divide by *mitosis* to *primary spermatocytes* (46 XY).
- Primary spermatocytes divide by *meiosis* to form *secondary spermatocytes* (23 X) and (23 Y).
- Each secondary spermatocyte divides into two *spermatids*.

2- Spermiogenesis

Which is the change in conformation of the spherical spermatids to adapt themselves for their purpose. A head, midpiece and a tail are developed.

- The *acrosome* (has digestive enzymes to penetrate *zona pellucida* and *corona radiata*) forms 2/3 of the head.
- The *midpiece* has a high number of *mitochondria*. It acts as the energy apparatus of sperm.
- The *tail* directs movement of sperm (lashing movement).
- Mature sperms are stored in the epididymis.



Fertilization

The sperm meets the secondary oocyte while it is undergoing *metaphase II*. It occurs after 12-24 hours *after* ovulation.

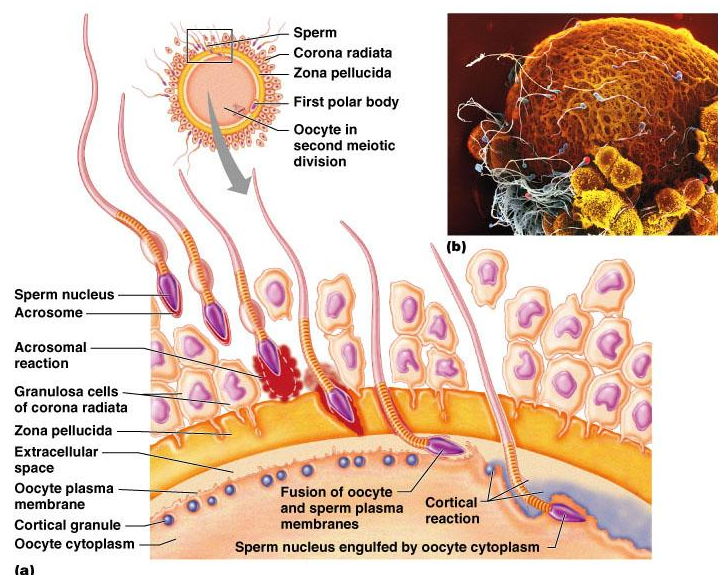
The ejaculate of the male has about 300 million sperms. Only 300 sperms will reach the ovulated oocyte at the *ampulla*. It takes 7 hours for the sperm to travel from the vagina to the oocyte. This is called the *accommodation period*.

Only one sperm enters the ovum (The sperm with the best capacitation: best characteristics)

When one sperm enters the ovum, the cell membrane of the ovum is *depolarized* to prevent other sperms from entering.

Fertilization occurs in three main phases:

1. **Capacitation:** epithelial interaction between the sperm and the female mucosa. It has to do with a physiological maturation process of the sperm cell membrane, which is seen as the precondition for the next step to follow, the acrosome reaction. The sperm with the most successful capacitation penetrates *corona radiata*.
2. **Acrosome reaction:** the penetration of zona pellucida when the receptors on the ovum called *zona pellucida 3 glycoproteins (ZP3)* give signals to the sperm to bind with the ovum and release the contents of the acromion so that the sperm can digest its way into the ovum.
3. **Fusion of membranes:** now the acromion has degenerated. The head enters the ovum and the *cell membranes* of the ovum and sperm *fuse* together. The midpiece and tail degenerate inside. The nucleus of sperm is now called the *male pronucleus* which then fuses with the female pronucleus to form the *zygote*.



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Oocyte response

1. Depolarization of membrane to prevent other sperms from entering. This happens by the deactivation of ZP3 receptors.
2. Completing metaphase II to form the pronucleus and the 2nd polar body.
3. Metabolic activation of the oocyte.

Results of fertilization

1. Restores diploid number of chromosomes.
2. Meiotic division of the oocyte is completed.
3. Sex is determined by the sperm. The diploid cell can be carrying XX or XY chromosomes.
4. 24 hours after fertilization mitosis is initiated (cleavage). The zygote starts dividing and growing.

Two-cell cleavage



Four-cell cleavage



Eight-cell cleavage



Events after fertilization

Day 3: cell division has produced 16 cells now. This is called **early morula**. (الجسم التوتوي)

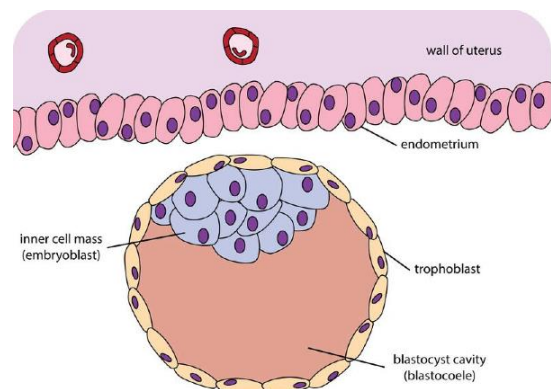
Day 4: 32 cells exist at the end of the uterine tube. They are connected by *desmosomes* to form a *sphere*.

The Morula is separated into 3 parts: inner cell mass, outer cell mass and a cavity by a process called **compaction**.

Day 5: morula is now called *wandering blastocyst* and it reaches the uterine cavity. *Mucus* from the uterine cavity enters the blastocyst and *fills* the cavity. *Note that the endometrium must be in its secretory phase.*

Day 6: the blastocyst implants itself in the *functional layer* of the endometrium to obtain nutrition. Zona pellucida must *disappear* for implantation to take place. If a woman *lacks* the enzymes that digest zona pellucida implantation will *not* be successful.

Outer cell mass is now called *trophoblast* (provides nutrition). Inner cell mass is now called *embryoblast* which will develop into an embryo. The cavity is called *blastocoel*.



If the woman is *highly active*, implantation may occur at the *internal os*. Which causes severe bleeding at birth and the death of the mother and the baby. This condition is called *placenta previa*, and a **c-section** is needed to deliver the baby.

Day 21 or 22 of the menstrual cycle: Little bleeding may occur during implantation as the functional layer is penetrated by the trophoblast and the blood vessels are disturbed. This is a *sign* of pregnancy.

Role of corpus luteum in implantation: it secretes *progesterone* to maintain the *secretory phase* and it lasts for 3 months.

Good luck