EMBRYOLOGY

Lec. No : 5

Dr. : Mohammad Al- Muhtaseb

Done by : تَالا الَّحیاَصَةَ
INDEX

FIRST ................................................................. 3
Then the uterus ...................................................... 3
Endometrium ........................................................... 4

The Menstrual Cycle .................................................. 5

The Menstrual Phase (the bleeding phase) .................... 7
The Proliferative, Follicular, or Estrogenic Phase ......... 8
The Secretory, or Luteal, Phase .................................. 9

Summary of Events of the Menstrual Cycle ................. 10

Cleavage of the Zygote and Implantation .................... 11

Important notes .......................................................... 12

Introduction to the next lecture
Fertilization ............................................................... 13
The doctor started the lecture by repeating some information from the last lecture.

**FIRST:**

There is a continuous relation between the anterior lobe of the pituitary gland, hypothalamus, the ovary and the uterus. Hypothalamus secretes gonadotropin hormones which regulate the secretion of the anterior lobe of the pituitary gland, so the anterior lobe of the pituitary gland secrete (FSH) which affect the ovaries and leads to growth of (from 10 - 20) primordial follicles every month but only ONE mature graafian follicle will be given.

The pituitary secretes luteinizing hormone (LH) in the day of ovulation (14) which reach the high level in the blood and affect the corpus luteum. There are two ways in front of the corpus luteum: If fertilization takes place, it's size will increase, it will secrete progesterone (It is important in the second half of the Menstrual Cycle) and corpus luteum of pregnancy will be formed, otherwise its size will decrease (shrink), the secretion of progesterone and estrogens will decrease, another menstrual cycle will take place and corpus albicans will be formed.

Graafian follicle secretes:

- estrogen
- activin
- inhibitor enzyme

**Then the uterus:**

Uterus is pear-shaped.
Made up of: fundus, body, cervix, and fallopian tubes on the side of the fundus.
The wall of the uterus consists of three layers:

- (a) endometrium or mucosa lining the inside wall.
- (b) myometrium, a thick layer of smooth muscle.
- (c) perimetrium, the peritoneal covering lining the outside wall.

In the uterus there is lining epithelium its kind is simple columnar epithelium, it converts into columnar ciliated (cilia) like the oviduct it must have cilia (simple cuboidal ciliated epithelium) which converts into simple columnar ciliated, this cilia is important in propulsion (دفع) of the fertilized ovum (zygote) toward the cavity of the uterus, (this movement is caused by cilia)

Myometrium: the muscular layer of the uterus, responsible for the delivery, it contracts during labor, and contraction continues (doesn't stop) until complete delivery of the baby. It consists of blood vessels which extent into the basal layer then into the functional layer.

**Endometrium:**

Endometrium: is so important because: In menstrual cycle, the layer that's shed during menstruation is part of the endometrium. Endometrium consists of 3 layers: *2 layers are called functional layers which are shed during menstruation but in implantation it becomes thick and contains glycogen, protein and fluid (edema),* and a basal layer which remains to renew the wall of endometrium

- The endometrium consists of epithelium and a lamina propria containing simple tubular glands that sometimes branch in their deeper portions
- Its covering epithelial cells are a mixture of ciliated and secretory simple columnar cells
- The endometrial layer can be subdivided into two zones:
(1) The basalis is the deepest one, adjacent to the myometrium; it contains lamina propria and the closed tips of the uterine glands
(2) The functionalis contains the remainder of the lamina propria and the glands, as well as the surface epithelium

- Whereas the functionalis undergoes profound changes during the menstrual cycles, the basalis remains mostly unchanged.
- Arcuate arteries are circumferentially oriented in the middle layers of the myometrium. From these vessels, two sets of arteries arise to supply blood to the endometrium: straight arteries, which supply the basalis, and spiral arteries, which bring blood to the functionalis.
- At the time of implantation, the mucosa of the uterus is in the secretory phase
- during which time uterine glands and arteries become coiled and the tissue becomes succulent.
- As a result, three distinct layers can be recognized in the endometrium: a superficial compact layer, an intermediate spongy layer, and a thin basal layer

• Normally, the human blastocyst implants in the endometrium along the anterior or posterior wall of the body of the uterus
• where it becomes embedded between the openings of the glands
• Basal layer is full of arteries and glands, changes occur to arteries and glands.

**The Menstrual Cycle:**

- Estrogens and progesterone control the organs of the female reproductive system.
- The proliferation and the differentiation of epithelial cells and the associated connective tissues depend on these hormones.
- After menopause, the diminished synthesis of these hormones causes a general involution of the reproductive organs.

( Reproductive system : تغير في الهرمونات يؤدي إلى تغير وضمور في الovaries and the uterus become smaller and they can’t do their functions.)
• After puberty, the ovarian hormones, under the stimulus of the anterior lobe of the pituitary, cause the endometrium to undergo cyclic structural modifications during the menstrual cycle (regular changes in the endometrium).

• The duration of the menstrual cycle is variable but averages 28 days. (in some women the duration of the menstrual cycle may be 30, 25, 35 days but the averages is 28 days)

• the menstrual cycle must be regular and has a fixed time.

• Menstrual cycles usually start between 12 and 15 years of age (at puberty age) and continue until about age 45–50 years (the menopause) during this time interval she is called fertile female, pregnancy can occur. During the menopause the hormones (Estrogens and progesterone) decrease and the woman become depressive.

• the female is fertile only during the years when she is having menstrual cycles.

• the beginning of the menstrual cycle is taken as the day when menstrual bleeding appears. The menstrual
discharge consists of degenerating endometrium mixed with blood from the ruptured blood vessels

- The **menstrual phase** lasts 3–4 days on average (bleeding phase)
- The next phases of the menstrual cycle are called the **proliferative** and **secretory** (or **luteal**) phases (corpus luteum is formed).
- The duration of the proliferative phase is variable, 10 days on average. The secretory phase begins at ovulation and lasts about 14 days.
- Regulation of Menstrual Cycle is very very important.

**The Menstrual Phase (the bleeding phase)**

- When fertilization of the oocyte and embryo implantation do not occur and the corpus luteum ceases functioning, the consequent rapid **decrease** (sudden drop) of blood levels of progesterone and estrogens causes menstruation.
- Several factors are involved in the shedding of the endometrium, such as cycles of contraction and relaxation of the spiral arteries, activation (by lack of progesterone) of locally produced matrix metalloproteinases, and local release of prostaglandins, cytokines, and nitric oxide.
- These factors lead to breakdown of blood vessel walls and basement membranes as well as collagen of the endometrial lamina propria.
• At the end of the menstrual phase, the endometrium is usually reduced to a thin layer of lamina propria, the blind ends of uterine glands (both of which present in the basalis layer)
• It occurs during 3 or 4 days, (it may take 4, 5, 6 days, week but it must be regular)
• the woman start counting from the 1st day of the bleeding
• The thickness of the endometrium of the uterus changes during this phase.
• During this phase the compact and spongy layers are expelled from the uterus, and the basal layer is the only part of the endometrium that is retained this layer, which is supplied by its own arteries, the basal arteries, functions as the regenerative layer in the rebuilding of glands and arteries in the proliferative phase

**The Proliferative, Follicular, or Estrogenic Phase**

It starts from the basal layer which regenerate the functional layer.
• After the menstrual phase, the uterine mucosa is relatively thin (about 0.5 mm).
• The beginning of the proliferative phase coincides with the rapid growth of a small group of ovarian follicles that, when the cycle began, was probably at the transition from preantral to antral follicles (under the effect of FSH 10-20 primordial follicles grow so it called Follicular Phase).
• **Estrogens** act on the endometrium, inducing cell proliferation and reconstituting the endometrium lost during menstruation. (Estrogen also acts on other parts of the reproductive system, eg, inducing the production of cilia by epithelial cells of the oviduct.)

• During the proliferative phase, the endometrium is covered by a simple columnar epithelium. The glands, formed by simple columnar epithelial cells, are straight tubules with narrow lumens.

• The gland’s duct was narrow then it become dilated and full of secretion.

• At the end of the proliferative phase, the endometrium is 2–3 mm thick.

• It lasts about 10 days (from the 4th to the 14th day, the day of ovulation).

• The arteries change from straight to spiral.

• The arteries under the effect of local secretion will have vasoconstriction أنقباب و تصيبق in order to prevent too much bleeding, that means the artery opens and little amount of blood will be lost then it closes.

### The Secretory, or Luteal, Phase

• The secretory phase starts after ovulation (from the 14th day to 28th day) and results from the action of **progesterone secreted by the corpus luteum**.

• Progesterone increases the thickness of endometrium for implantation.

• Acting on glands already developed by the action of estrogen, progesterone further stimulates the gland cells. (the diameter of glands will increase)

• The epithelial cells begin to accumulate glycogen below their nuclei.

• Glycoprotein secretory products dilate the lumens of the glands.

• One important feature of this phase is that the glands and arteries become highly coiled (spiral).

• In this phase, the endometrium reaches its maximum thickness (5 mm) as a result of the accumulation of secretions and of edema in the stroma.

• Mitoses are rare during the secretory phase.
• If fertilization has taken place, the embryo has been transported to the uterus and attaches to the uterine epithelium during the secretory stage, around 7 or 8 days after ovulation.
• The glands have much glycogen and protein.
• It is thought that the secretion of the glands is the major source of embryonic nutrition before embryo implantation.

**Summary of Events of the Menstrual Cycle**

**Stage of Cycle:**

* **Proliferative:**
  - **Main actions of pituitary hormones** Follicle-stimulating hormone stimulates rapid growth of ovarian follicles.
  - **Main events in the ovary** Growth of ovarian follicles; dominant follicle reaches preovulatory stage.
  - **Dominant ovarian hormone** Estrogens, produced by the growing follicles, act on vagina, tubes, and uterus.
  - **Main events in the endometrium** Growth of the mucosa after menstruation.

* **Secretory or Luteal**
  - **Main actions of pituitary hormones** Peak of luteinizing hormone at the beginning of the secretory stage, secreted by stimulation of estrogen, induces ovulation and development of the corpus luteum.
  - **Main events in the ovary** Ovulation. Development of the corpus luteum. Degeneration of the corpus luteum.
  - **Dominant ovarian hormone** Progesterone, produced by the corpus luteum, acts mainly on the uterus.
  - **Main events in the endometrium** Further growth of the mucosa, coiling of glands, secretion.

* **Menstrual**
  - **Dominant ovarian hormone** Progesterone production ceases.
  - **Main events in the endometrium** Shedding of part of the mucosa about 14 days after ovulation.
Cleavage of the Zygote and Implantation

In implantation the endometrium must be ready to this process especially in the secretory phase, it becomes thick and more secretion will occur in the gland.

Cleavage: Mitotic cell division after fertilization, multiple divisions.
Morula: the embryo when it consists of 16 cells called blastomeres, so it is a group blastomeres.

Repeated mitotic divisions occur to the zygote, resulting in a rapid increase in the number of cells, two, four, eight, then sixteen, when we reach this stage of 16 cells we call it Morula (تكونت بعد 4 أيام من الـ fertilization). After the morula enters the uterus a fluid filled cavity forms inside the morula. The embryo is now called a blastocyst (في اليوم الخامس) which contains an inner cell mass or what we call embryoblast that forms the embryo. This blastocyst implants itself in the anterior or posterior wall of the uterus, this process is called Implantation.
The implantation is between the 7th and 9th days after fertilization (7th: superficial implantation, 9th: complete implantation)
Fertilization = zero time.
The morula cells after the forming of the cavity form 2 types:
   1- Inner cell mass or embryonic mass (خلايا مصممة)
   2- Trophoblast cells (خلايا محيطة)

The Zygote spend 4-5 days in the fallopian tube before reaching the cavity of the uterus.
Important notes:

* the menstruation doesn't stop suddenly at the menopause it may occur after or before its fixed time. During the fertile period (15-50 years) the menstrual cycle must be regular and this is sign for fertility.

* during the menstrual phase: the sloughing occur to the functional layer of the endometrium and epithelial tissue, some secretion, blood from arteries, mucosa from the glands.

* in the 28th day there are two choices
  1- next menstrual bleeding.
  2- or there is a zygote (pregnancy).

* the sperm lives 72 hours.
  Mature ovum lives 48 hours.
  During this time interval the fertilization occur.

* at ovulation, usually, the temperature of the female's body increases (0.5 - 1) degree, this is sign for fertilization.

* The safety period: is the week around the 14th day (3 days before it and 4 days after it). It can be used to prevent pregnancy without using contraceptive pills. But sometimes pregnancy occurs because: the sperm may may lived several days, or the mature ovum was released in the 16th day so the fertilization occurred.

* human chorionic gonadotropin hormone: this hormone is took from the blood or urine to know if there is pregnancy or not.
Fertilization, the process by which male and female gametes fuse, occurs in the **ampullary region of the uterine tube**, this is the widest part of the tube and is close to the ovary.

- Spermatozoa may remain viable in the female reproductive tract for several days.
- Only 1% of sperm deposited in the vagina enter the cervix, where they may survive for many hours.
- Movement of sperm from the cervix to the oviduct is accomplished primarily by their own propulsion, although they may be assisted by movements of fluids created by uterine cilia.
- The trip from cervix to oviduct requires a minimum of 2 to 7 hours, and after reaching the isthmus, sperm become less motile and cease their migration.
- At ovulation, sperm again become motile, perhaps because of chemoattractants produced by cumulus cells surrounding the egg, and swim to the ampulla where fertilization usually occurs.
- Spermatozoa are not able to fertilize the oocyte immediately upon arrival in the female genital tract but must undergo
  
  (a) **capacitation and**

  (b) the **acrosome reaction to acquire this capability.**
Notes:
* second meiotic division is completed after fertilization.
* 1% of sperms reach the ampulla of the uterine tube. 1 sperm causes penetration
* zona pellucida is found around the secondary ovum (oocyte), it causes attraction to 1 sperm, after penetration changes will occur to the composition of zona pellucida and the receptors become blocked so no other sperm can make penetration.
* after penetration the nucleus of the secondary oocyte is called female pronucleus
* nucleus of the sperm (it’s in the head), after the secretion of hydrolytic enzyme which makes lysis to the zona pellucida to make penetration, is called male pronucleus.
* the female pronucleus and the male pronucleus fuses (46 chromosomes), then the sex of the embryo can be determined.
* the sex of the embryo can be determined after fertilization and fusion of the female pronucleus and the male pronucleus.
* then division occurs, and the DNA duplicates.
* it’s important to know that the size of the cell will not change, the size of the blastomeres will change.
* the sperm consist of:
  • head
  • acrosome
  • middlepiece containing mitochondria to provide energy.
  • tail
* Uterine tubes (Fallopian) consist of:

- ampulla
- isthmus
- infundibulum, fimbriae
- intramural part.

DONE BY: TALA AL-HYASAT