Ministry of health Republic of Belarus
Establishment of education "Gomel state medical university"

Department of histology, cytology and embryology

MANUAL
for 1-st year students of faculty of foreign students on gynecology

Topic: 13:
HISTOPHYSIOLOGY OF THE FEMALE REPRODUCTIVE SYSTEM

Duration 4 hours

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THE MOTIVATIONAL CHARACTERISTIC OF THE THEME

Organs of sexual system take part in maintenance and safety of a biological kind owing to inherent in them reproductive functions. Function of sexual glands is important also endocrine.

Gynecologic practice in many respects is based on knowledge of the basic laws of the structurally functional organization of female sexual system. Their feature in norm cyclicity of realization reproductive and endocrine functions.

THE PURPOSE

Studying of a microscopic and ultramicroscopic structure and Histophysiology of ovary and organs of a sexual system, a uterus and vagina.

PROBLEMS

The student should know:

1. The structure of ovary and process of maturing of follicles.
2. Stages of formation of a yellow body
3. The menstrual cycle and its regulation.
4. Oogenesis
5. Hormones regulation

The student should be able:

1. To define at a microscopic level of female sexual system and their elements.
2. To explain mechanisms of cyclic activity of organs of female sexual system and their regulation.
3. To explain features and developments of organs of female sexual system.

REQUIREMENTS TO THE INITIAL LEVEL OF KNOWLEDGE

For full mastering a theme it is necessary for student to repeat from a rate of medical biology and genetics oogenesis and a structure oocytes.

CONTROL QUESTIONS FROM RELATED SUBJECTS

1. Oogenesis its features.
2. Development of female sexual system.
3. Hormones of female sexual system

CONTROL QUESTIONS ON THE THEME

1. Ovary . Development, a structure and functions. Age changes.
2. Ovulation
3. Follicles of ovary and their versions.
4. A vagina, a structure, cyclic changes
5. A mature follicle..
6.. Menstrual cycle
7. A yellow body, stages of development, function.
8. A uterus. Development and structure

THE PRACTICAL PART

1. The Scheme of oogenesis – to enter designations (Exercise №1 in album)

2. The Diagram of changes in ovary – to bring designations (Exercise №2 in album)
3. Microscopy histological preparations and their sketch (Exercise № 3, 4, 7 and 8 in album)
4. Cyclic changes in bodies of female sexual system (Exercise №6 in album)
5. To study diagrams

SLIDES
1. Ovary
2. Corpus luteum
3. Uterus
4. Uterine tube

QUESTIONS FOR SELF-CHECKING KNOWLEDGE
1. Ovary. Development, structure and functions. Age changes.
2. Oogenesis, it stages. Difference of oogenesis and spermatogenesis.
3. Ovary follicles, their types.
4. Blood-ovary barrier.
5. Mature follicle. Ovulation.
6. Atresia of follicles. Corpora atretica.
7. Corpus luteum, stages of development, functions.
8. Endocrinal functions of the ovary.
9. Development and tissue structure of the uterine tubes.
10. The uterus. Development, structure, tissues.
11. Endometrium in:
    a) menstrual stage;
    b) proliferate stage;
    c) secretary stage.
12. Vagina, structure, cycling changes.

HISTOPHYSIOLOGY OF THE FEMALE REPRODUCTIVE SYSTEM

Functions of female reproductive system:
1) reproductive (the formation of ovum);
2) endocrine (the production of hormones – estrogens and progesterone that are responsible for the development of the female secondary sex characters and regulate cyclical changes in the uterus and maturation of the oocytes) [1].

Ovarian follicles are structural and functional units of the ovaries. Ovarian follicles consist of one primary oocyte and surrounding follicular cells.

Classification of follicles
I) Primordial follicles;
II) Growing follicles or developing follicles:
1) primary:
   a) early,
   b) late;
2) secondary or antral

III) Mature or Graafian follicles

The primordial follicle consists of:

1) the primary oocyte at the diplotene stage of first meiotic prophase (in period of long growth) and

2) one layer of flattened follicular cells lying on basement [1, 2].

Specific features of oogenesis

1) Oogenesis takes place in two organs of female reproductive system. It begin in ovary and finish in oviduct.

2) The first mitotic stage of oogenesis takes plase in ovary in period of early embryonic development, when oogonia divide mitotically to produse primary oocytes in the fetal ovary.

3) The miotic stage of oogenesis begin in ovary in period of embryonic development, when the primary oocytes enter prophase of the first meiotic division. First meiotic division is then arrested at the diplotene stage of first meiotic prophase and the primary oocytes consisting of primordial follicles remain in this condition throughout the remainder of gestation, childhood and puberty. This long period of oogenesis is independent of gonadotropin stimulation.

4) During puberty and reproductive life span, small groups of primordial follicles (5 to 30) undergo cyclic growth and maturation each menstrual cycle. It is accompanied by the process of the primordial follicle transformation into the Graafian follicle. This short growth is regulated by FSH and lasts for about 14 days.

5) Normally, only one primordial follicle reaches full maturity and only one secondary oocyte is released from the ovary during each menstrual cycle [2].

By the sixth month of gestation about 7 million oocytes and oogonia are present in the ovaries.

By the time of birth this number is reduced to about 2 million.

Of these only about 400.000 survive until puberty. And only about 400 oocytes ovulate. Most ovarian follicles undergo a degenerative process called follicular atresia in which follicular cells and oocytes die and are destroyed by phagocytic cells.

The early primary follicle is the first stage of follicular maturation

The early primary follicle consists of: the primary oocyte that begins to enlarge in size; forming zona pellucida between oocyte and the adjacent follicle cells; 2) one layer of cuboidal or columnar follicular cells [1].

The late primary follicle consists of:

1) the primary enlarging in size oocyte; zona pellucida; stratum granulosum, surrounding the oocyte and presenting by the granulosa cells; 4) theca folliculi that is a sheath of connective tissue cells, lying just external to the basal lamina and surrounding the follicle from outside.

The secondary follicle consists of:

1) the eccentrically positioned primary oocyte that undergoes no further growth;

2) zona pellucida;

3)stratum granulosum with cavity called the foilicular antrum filling by the liquor folliculi with estrogens, producing by granulosa cells;

4) theca folliculi that differentiates into:

a) a theca interna (loose connective tissue containing cuboidal secretory cells, secreting the androgens that are the precursors of estrogens;

b) a theca externa (dense connective tissue) [3].

The Graafian follicle consists of:

1) primary oocyte embedded within the cumulus oophorus and surrounding by corona radiata cells;

2) one large antrum;

3) granulosa cells;

4) theca folliculi:

a) a theca interna;

b) a theca externa.

Blood-ovarian barrier

The blood-ovarian barrier separates capillary bed of the theca interna from the oocyte. It includes:

1) Capillary's endothelium with basal membrane

2) Connective tissue of the theca interna

3) Basal membrane of granulosa layer

4) Granulosa layer

5) Corona radiate

6) Zone pellucida [2].

A surge in the release of FSH or LH is induced in the adenohypophysis approximately 24 hours before ovulation.

Triggered by this surge, the first meiotic division of the primary oocyte resumes resulting in the formation of the secondary oocyte and the first polar body.

Ovulation is the process by which a secondary oocyte surrounding by the corona radiata is released from the ruptured Graafian follicle.

Ovulation takes place in the middle of the menstrual cycle (i.e., on the 14th day of a 28-day cycle). Ovulation is induced by a surge in the LH level. Factors, providing the process of ovulation are:

increase in the volume and pressure of the follicular fluid;

proteolytic activity of the follicular wall enzymes;

hormonally directed deposition of glycosaminoglycans between the oocyte–cumulus complex and the stratum granulosum;

contraction of the smooth muscle cells in the theca externa layer [2].

After ovulation the oocyte enters the infundibulum of the uterine tube, where it is may be fertilized. As the secondary oocyte leaves the follicle at ovulation, the second meiotic division (equatorial division) is in progress. This division is arrested at the second metaphase and is not completed unless the secondary oocyte is penetrated by a spermatozoon.

If fertilization occurs, the secondary oocyte completes the second meiotic division and forms a mature ovum with the maternal pronucleus containing a set of 23 chromosomes.

If the oocyte is not fertilized within the oviduct the first 24 hours after ovulation, it begins to degenerate [1 – 3].

Atresia

Most of the follicles degenerate and disappear through a process called ovarian follicular atresia with formation of atretic follicles in ovary.

In atresia the granulosa cells and oocyte undergoes degeneration, the zona pellucida becomes folded and collapses within the cavity of the follicle, but the theca interna cells enlarge in atretic follicles.

These thecal cells are called interstitial cells. These cells, presenting in ovary from childhood through menopause are the source of ovarian androgens and finally estrogens.

After ovulation, the remainders of the follicle in the ovary form a temporary endocrine gland called the corpus luteum (yellow body).

It is localized in the cortical region of ovary and secretes progesterone [3].

The corpus luteum development

Process of corpus luteum formation includes:

1) rapidly growth of blood and lymphatic vessels from the theca interna into the granulosa layer;

2) luteinization that is the process when the theca interna cells differentiate into theca lutein cells and granulosa cells differentiate into granulosa lutein cells. Lutein cells are steroid-secreting cells that begin to produce progesterone. This hormone stimulates the growth and secretory activity of the uterus lining endometrium, to prepare it for the implantation of the germ. The cyclic development of ovarian follicles is also blocked by the progesterone.

3) degeneration of corpus luteum when it transforms into a corpus albicans – whitish scar tissue within the ovaries.

If fertilization and implantation do not occur, the corpus luteum remains active only for 14 days; in this case it is called the corpus luteum of menstruation.

If fertilization and implantation occur, the chorionic gonadotropin producing by the placenta will be stimulate the corpus luteum to increase in size to form the corpus luteum of pregnancy, which is active for about 6 months of gestation [2].

The uterine tubes

Each uterine tube can be divided into four segments:

1) The infundibulum is the funnel-shaped segment of the tube adjacent to the ovary. Fringed extensions called fimbriae extend from the infundibulum toward the ovary;

2) The ampulla is the longest segment of the tube, that is the site of fertilization;

3) The isthmus is the narrow, medial segment of the uterine tube adjacent to the uterus;

4) The uterine part lying within the uterine wall and opens into the cavity of the uterus

The wall of the oviduct is composed of 3 layers:

I) mucosa consisting of:

1) simple columnar epithelium;
2) lamina propria – loose connective tissue
II) muscularis consisting of:
1) inner circular layer and
2) outer longitudinal sublayers of smooth muscle tissue;
III) serosa

The mucosa exhibits thin longitudinal folds that project into the lumen of the uterine tube.

The epithelium lining the mucosa of oviduct contains 2 types of cells:

1) Ciliated cells that are most numerous in the infundibulum and ampulla. The wave of the cilia is directed toward the uterus;

2) Nonciliated or peg cells that are secretory cells producing the fluid with nutritive material for the ovum and the early embryo [1].

The uterine

The uterine wall is composed of three layers.
Endometrium – the mucosa of the uterus.
Myometrium – the thick muscular layer.
Perimetrium – the external serous layer.
The *endometrium* consists of
1) epithelium – simple columnar and
2) lamina propria containing simple tubular glands.

Epithelium of endometrium contains a) ciliated and b) secretory cells. The secretory cells produced mucous.

Phases of the menstrual cycle

- There are three phases of the menstrual cycle:
- 1) Menstrual or desquamation phase
- 2) Postmenstrual or proliferative phase
- 3) Premenstrual or secretory phase [1 – 3].

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