FEATURES OF THE STRUCTURE OF THE REPRODUCTIVE ORGANS OF THE FEMALE BODY

Xalimova Yulduz Saloxiddinovna
Xafizova Muxarram Ne'matillaevna
Asian International University

The article provides basic information about the features of the female gonads, reflects data on the morphology and histofunctional relationships of the main structures of the ovary in various periods of postnatal ontogenesis. A critical analysis of the literature in recent years has revealed controversial points, which led to the conclusion that it is necessary to apply an integrated approach to the study of ovarian morphology

The organs of the female reproductive system include the sex glands - ovaries, auxiliary genitalia (oviducts, uterus, vagina, external genitalia), as well as mammary glands.

The LRS bodies perform the following functions:

1. generative - the formation of female gametes, as well as fertilization and gestation of the fetus

2. reproductive – participation in the processes of fertilization, gestation and childbearing

3. endocrine - the production of sex hormones, mainly estrogens and progestogens.

Development of the organs of the female reproductive system

The development of the organs of the female reproductive system proceeds in 2 stages and is associated with the development of the urinary system:

1. the indifferent stage

2. the stage of sexual differentiation

In the indifferent stage, at 3-4 weeks of embryonic development, the genital gonads are laid on the ventrolateral surface of the primary kidneys in the

form of genital rollers. Genital rollers are ridge-like thickenings consisting of clusters of mesenchymal cells covered with a coelomic epithelium. The coelomic epithelium grows into the mesenchyma in the form of cords, further forming genital cords. At the same time, a parallel paramesonephral (Muller) duct is split off from the mesonephral (Wolf's) duct, from which the excretory pathways of the LC develop further.

A little earlier than these processes, at the 3rd week of embryogenesis, primary germ cells - gametoblasts - are formed in the endoderm of the wall of the yolk sac, which multiply rapidly and enter the mesenchyma or with blood flow and are embedded in the epithelium of the cords of the genital rollers. This is the end of the indifferent stage.

Specific gender differences in development occur at 6-7 weeks of embryogenesis, from which point sexual differentiation of the genitals begins. Differentiation according to the female type is due to karyotype 46(XX), i.e. it occurs in the absence of the Y chromosome, which determines the development of the testicles.

At this time, the separation of the future ovary from the primary kidney occurs with the formation of a vascular pedicle - mesovarium.

The genital cords in the ovary, consisting of epithelial and germ cells, are separated by layers of connective tissue into separate islets - egg-bearing balls. Egg-bearing balls are formations consisting of 1, rarely 2 germ cells (ovogonia) and several high epithelial cells. In the ovary tab, the balls lie superficially - here a cortical substance will be formed in the future. The deeper part of the gonad is devoid of these balls - this is the future brain matter. Stem cells of the mechanoblast type migrate from the germinal mesoderm to the bookmark, which subsequently create a protein shell and a connective tissue stroma of the organ. The strands of the forming stroma divide the egg-bearing balls into smaller formations, in parallel with this, the ovogonies enter the stage of reproduction (divide), reaching the zenith at the twentieth week of embryogenesis, when 3-4 million germ cells are formed in the forming ovary, epithelial cells located

between the genitals multiply. About half of the ovogonies from the 3rd month of development begin to differentiate into first-order ovocytes (the period of small growth), entering the prophase of the 1st division of meiosis. If the germ cell is not surrounded by epithelial cells during this time, then it dies. Eventually, by seven months of intrauterine development, each first-order ovocyte acquires a shell of one layer of flat follicular epithelial cells, forming a structure called a primordial follicle. At this stage, the ovocyte of the 1st order is preserved, as it were, until the individual reaches puberty.

By the end of the first half of intrauterine development, almost all the main structures are differentiated in the ovary: cortical and medulla, and on the surface there is a protein shell covered with cubic epithelium.

By the time of birth, the ovary increases, and the number of ovogonia progressively decreases due to their death, therefore, by the 9th month of embryogenesis, the total number of germ cells – ovocytes of the 1st order in the primordial follicles is 300-400 thousand. During the first year of life, the formation of the connective tissue stroma and the ovarian membrane ends.

There are 3 main factors involved in the regulation of the processes of structural differentiation and functional activity of the ovary in the prenatal period:

1. gonadotropins of the pituitary gland of the mother
2. choriogonin of the placenta
3. gonadotropins of the pituitary gland of the fetus (minimal involvement).

The development of the LRS excretory pathways occurs from the paramesonephral ducts. They form next to the Wolf ducts, which are then reduced. The Muller ducts initially represent cellular strands, in the amount of 2, in which a lumen appears, and they take the form of tubes. From the upper part of the ducts, the oviducts are formed, and from the distal sections, as a result of their fusion, the uterus and the upper third of the vagina are formed. At first, the uterus has a two-horned shape, and then it becomes pear-shaped. The lower 2/3 of the vagina is formed from the cloaca.

The final formation of the ovary as a generative and endocrine organ occurs by the period of puberty - 8-13 years. During this period, the hypothalamic-adenohypophysial system begins to function actively. Under the control of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) of the pituitary gland, the secretion of sex steroids by the ovaries leads to the development of secondary sexual characteristics and the formation of reproductive function.

Morphology of the ovaries

The ovary (ovarium) is a paired parenchymal organ in which constant changes occur related to the hormonal status of a woman. The ovary performs two functions - generative (formation of mature female germ cells - ovogenesis) and endocrine (synthesis of female sex hormones).

The ovaries have an ovoid shape, a length of 2-5 cm, a weight of 6-8 grams and are located in the pelvic cavity. From the surface, they are covered with mesothelium (and not the entire thickness of the peritoneum, which facilitates ovulation), under which there is a protein shell consisting of dense fibrous connective tissue lying in 3 layers. The layers are differentiated from each other by the arrangement of elastin and collagen fibers. In the ovary, the cortical substance located outside and located deep in the organ are isolated, their stroma is RVNST. The ratio of cortical and cerebral matter to the period of puberty is 3:1. With an increase in the age of a woman and a shortening of the reproductive period, atrophy of the cortical substance occurs, which is replaced by brain matter. By the age of 45-50, when the reproductive period ends, the ratio of cortical and cerebral matter is 1:3. In the stroma of the cortical substance there are generative elements: follicles at various stages of maturation, yellow, atretic and white bodies. The medulla is formed by loose connective tissue with large trunks of arteries, veins, lymphatic vessels and nerves. Interstitial cells that produce estrogens and become active during the premenstrual period and during pregnancy are located around blood vessels in the stroma of the medulla. In addition, in the area of the ovarian gate, there are chymous (hylus) cells in the medulla that produce androgen hormones.

Ovogenesis, cyclic changes in the ovaries (ovarian cycle)

Ovogenesis occurs in the cortical substance - the process of maturation of female germ cells. It includes three periods:

The period of reproduction - occurs in utero, starting from the 6th week of embryogenesis, and ends before birth; therefore, throughout the subsequent life of a woman, the ovary serves as a "repository" of germ cells. By 3-4 months. During intrauterine development, about 3-4 million ovogonies are formed. Up to 95% of ovogonia die by 7 months, and the rest enter a period of growth.

The period of ovogenesis growth consists of two phases: small and large. From the 7th month of intrauterine development until puberty, the phase of small growth lasts. It occurs in the absence of hormonal stimulation. At the same time, ovogony enters the prophase of the first meiosis, reaches the stage of diplotene, and already the 1st-order ovocytes enter a long dormant phase (several decades), which lasts until puberty. During this phase, an average of 300-400 thousand oocytes of the first order are located in the girl's ovary, located in the primordial follicles. These are the youngest and smallest follicles, which are located directly under the capsule of the organ. In the center of such a follicle is an ovocyte of the first order, surrounded by a single-layer flat follicular epithelium and a basement membrane.

The phase of great growth begins from the moment of puberty, when, under the action of pituitary FSH, the periodic involvement of primordial follicles in cyclic development begins, culminating in their maturation. Its duration is 12-14 days.

During the large growth phase, the primordial follicles turn into primary follicles. Their size increases due to changes occurring both in the ovocyte itself and in the cells of the follicular epithelium.

The volume of the ovocyte increases mainly due to an increase in the content of organelles in it. Due to the activation of a special gene, the ovocyte of the first order, as well as follicular cells, secrete mucoproteins and GAG towards each other, forming a shiny shell (zona pellucida) in the space between the

ovocyte and the follicular epithelium. The shiny shell contains radially located pores into which the microvilli of the ovocyte and cytoplasmic processes of follicular epithelial cells penetrate to establish intercellular contacts in order to transfer nutrients. Follicular cells acquire a cubic shape and lie in 1-2 layers around the ovocyte.

In the future, the primary follicles turn into secondary or growing follicles. Under the influence of FSH, follicular epithelial cells begin to intensively divide by mitosis, fit into several layers, forming a multilayer follicular epithelial layer or a granular shell. It is so called because the cytoplasm of the cells on the preparations is not visible, but only the nuclei resembling grains are visible. The cells of the granular shell change their shape: they turn from cubic to cylindrical, and acquire secretory ability. The cells of the inner layer of the granular shell adjacent to the shiny shell are located perpendicular to it, forming a radiant crown or crown, which plays an important role in the trophism of the ovocyte. During the ongoing mitotic division of the cells of the granular layer, there are many of them, therefore, a lot of their secretions are formed. Nutrients do not have time to be absorbed by the ovocyte of the first order, their excess begins to be deposited between follicular cells in the form of droplets, which are called follicular fluid, containing a variety of substances, including female sex steroids - estrogens. The liquid accumulates, first forming several small cavities, which later merge into 2-3 large ones. As the follicle grows, connective tissue begins to surround it, which thickens over time, giving rise to the outer shell of the follicle - theca folliculi or follicle cap.

During the ongoing growth, small cavities with follicular fluid merge to form a single cavity that occupies the main volume of the follicle and contains a secret with a large amount of estrogens (the concentration of estradiol in the follicular fluid exceeds its level in the blood by 1000 times.), as well as gonadocrinin, prostaglandins. As fluid accumulates and the cavity increases, it pushes the ovocyte of the first order to the periphery to the upper pole of the follicle protruding above the surface of the ovary. An egg-bearing mound or

tubercle (cumulus oophorus) is formed here. It consists of an ovocyte of the first order, surrounded by a shiny shell, a radiant crown and several layers of follicular cells.

This is how a mature or tertiary follicle is formed, which is called a Graaf bubble, its dimensions reach 2 cm in diameter.

The wall of the tertiary follicle consists of 2 parts:

1. Multilayered follicular epithelium - granulosa or granular layer located on a well-defined basement membrane (vitreous membrane of the Slavic).

2. The connective tissue part is the teka (tire), in which two layers are distinguished:

The inner layer (theca interna). RNST is presented with a large number of blood capillaries. It contains interstitial (tecal) cells with rounded nuclei.

The outer layer (theca externa) is formed by dense fibrous connective tissue.

It should be noted that 99% of the primordial follicles entering a period of great growth die during the entire reproductive period and only 400-500 follicles reach the Graaf vesicle stage in their entire life.

The final stage of follicle maturation is ovulation. Immediately before ovulation, the oviparous tubercle loses its connection with the follicle wall, and the ovocyte of the first order, together with the radiant crown, begins to float freely in the follicular fluid. At the same time, the increasing concentration of luteinizing hormone in the blood causes the entry of an ovocyte into the 3rd period of ovogenesis - the period of maturation. It completes the prophase of the first division of meiosis and quickly passes the remaining stages of the first division: metaphase, anaphase and telophase, with the formation of an ovocyte of the 2nd order and one directional (reduction) body. A further increase in the volume of the vesicle and the pressure in it leads to stretching and thinning of both its outer shell and the albuminous membrane of the ovary. Thinning is accompanied by compression of the blood vessels of these membranes, and the formation of a necrotic area called stigma. As a result of the increasing intra-follicular pressure,

the stigma breaks and the ovocyte of the second order (surrounded by a radiant crown) and the directional body (located somewhere in the shells) with a diploid set of chromosomes are released. Thus, ovulation is a rupture of a mature tertiary follicle provoked by LH of the anterior lobe of the adenohypophysis.

The ovocyte of the second order penetrates into the lumen of the fallopian tube. If fertilization occurs, the sperm entering the cell stimulates the completion of the second meiotic division. In this case, 2 cells with haploid sets of chromosomes are formed from an ovocyte of the second order: one of them is a directional body; the second is an egg – a female mature sexual gamete. It can be said that as a result of meiosis, one ovocyte of the first order produces one egg and three directional corpuscles (if the first corpuscle also undergoes a second division).

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