

**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: 15:  
**HUMAN EMBRYONIC DEVELOPMENT (EXTRA-EMBRYONIC ORGANS)**

Duration 4 hours

Authors:

Associate Professor Ph.D.

Associate Professor Ph.D.

Kravtsova I.L.

Solodova E.K.

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## THE MOTIVATIONAL CHARACTERISTIC OF THE THEME

Studying embryonic developments of the person allows finding out the general features in embryogenesis of the person and at the same time to establish features of development of a germ of the person. The knowledge of processes of fertilization, cleavage, implantation, gastrulation, and also features of development of a placenta, and extra embryonic organs and its medical value. It enables to comprehend and estimate all cycle of the biological phenomena accompanying current of pregnancy and development of a fetus. Rational supervision of pregnant women, conducting sorts, realization of many medical and preventive actions in obstetrics and is impossible for gynecology without a profound knowledge of embryology.

## THE PURPOSE

Studying and mastering of essence and features of the consecutive, causally-caused processes embryogenesis the person.

## PROBLEMS

### **The student should know:**

1. A structure and value of trophoblast.
2. Morphology of the structures providing interaction in system mother-fetus.
3. Development, a structure and function amnion, and yolk sac.
7. Features of a structure of a placenta of the person.
8. To know interrelation between a developing embryo of the person, extra embryonic organs.
9. To know about the critical periods of development of the person.

### **The student should know: be able:**

1. To define the basic structures which are a part of a placenta and umbilical cord.

## REQUIREMENTS TO THE INITIAL LEVEL OF KNOWLEDGE

For full mastering a theme it is necessary for student to repeat stages of embryonic developments of the person and questions from medical biology and the genetics, connected with process of gastrulation.

## CONTROL QUESTIONS FROM RELATED SUBJECTS

Human extraembryonic organs.

## CONTROL QUESTIONS ON THE THEME

1. Implantation.
2. Formation of epiblast and hypoblast
3. Amnion. Its features at the person.
4. Yolk sac. Its features at the person.
5. Chorion, a structure and functions.
6. A structure secondary and tertiary villi.
7. A structure and functions of a placenta
8. Blood- placental barrier.
9. A structure and functions of an umbilical cord.

10. Changes in a structure of mucous and muscular membrane of a uterus during pregnancy.

12. The critical periods of embryology

### THE PRACTICAL PART

1. Scheme of a structure of an early stage embryogenesis in the person-enter designations (Exercise №1, 2 in album).

2. The scheme of development extra embryonic organs -enter designations (Exercise № 3 in album).

3. The scheme of blood circulation in placenta, structure of placenta and maternal parts, placental barrier (Exercise 4, 5, 6, 7 in album)

### SLIDES

1. Placenta

2. Umbilical cord

### QUESTIONS FOR SELF-CHECKING KNOWLEDGE

1. Differentiation of trophoblast

2. Structure of primary villi. Implantation

3. Formation of amnion and yolk sac. Extra-embryonic mesenchyme.

4. Amnion.

5. Yolk sac and allantois

6. Chorine .structure and function.

7. Structure of 2-ndry and 3-dly villi

8. Structure and function of placenta

a)Mother part

b) Fetal part

9. Placental barrier

10. Structure and functional of umbilical cord

11. Changes in the wall of uterus during pregnancy.

12. Critical periods of human embryogenesis

## HUMAN EMBRYONIC DEVELOPMENT (EXTRA-EMBRYONIC ORGANS)

**Early:** amnion, yolk sac, chorion. They are developed in period of early gastrulation (7-14 day). **More late:** allantois, umbilical cord, placenta [1].

### AMNION

The amnion is cavity filled with an amniotic fluid which creates the environment for embryo. The amnion is developed from the amniotic sac, which appears in period of early gastrulation from the epiblast.

The wall of amnion consists of 2 layers:

**outer** – loose connective tissue of amnion, developing from extraembryonic mesoderm;

**inner** – amniotic epithelium, developing from extraembryonic ectoderm.

*Main functions of the amnion*

1. Secretion of amniotic fluid and it is absorption by microvilli of epithelial cells
2. Protection the embryo against some trauma
3. Control embryonic body temperature

The amnion grows till 37 week of embryo development, when it contains almost 1 liter of liquid [1 – 3].

The amniotic membrane, chorion and endometrium of the uterus, which surrounds the embryo after implantation, together form the amniotic sac. During childbirth, this bubble bursts and, as a result, amniotic fluid departs.

Fetal metabolic products are released into the amniotic fluid. His kidneys and gastrointestinal tract function, so the cells of the amniotic epithelium are actively involved in the removal of decay products [1].

## **YOLK SAC**

The yolk sac is cavity with two layers in wall:

**outer** – loose connective tissue of yolk sac, developing from extraembryonic mesoderm;

**inner** – yolk sac epithelium, developing from extraembryonic endoderm.

It appears in period of early gastrulation as primitive sac from the hypoblast.

*Main function of the yolk sac*

1. Blood development occurs in its walls beginning in week 3 and continues to form there until the hematopoietic activity begins in the liver at about week 5.
2. Primordial germ cells appear in the yolk sac wall in week 3 and after migrate to the developing gonads where they become germ cells (oogonia and spermatogonia).

Connecting stalk is extraembryonic mesoderm connecting the embryo with the trophoblast.

With development of blood vessels, the connecting stalk becomes the umbilical cord. At this the extraembryonic mesoderm of the connecting stalk gives rise to the special mucous tissue of the umbilical cord called Wharton's jelly [1].

## **ALLANTOIS**

In the second phase of gastrulation, an epithelial cord begins to grow from the roof of the yolk sac and the amniotic stalk - the rudiment of allantois. In humans, this organ remains poorly developed, being included in the umbilical cord.

*Main functions of the allantois*

1. Induces the rapid formation of umbilical vessels. Which connect the circulatory system of the fetus with the capillaries of the chorion.
2. The proximal area of the allantois forms part of the bladder transitional epithelium.

## **CHORION**

*Main function of the chorion*

1. Protection of the forming embryo

2. Nutrition of the forming embryo
3. Placenta formation

**Implantation** is sinking the embryo into the endometrium

During implantation, the trophoblast differentiates into 2 layers:

Inner cellular layer – **cytotrophoblast**. Outer noncellular layer – **syncytiotrophoblast**. Implantation starts about the 7 day of embryonic development

After implantation of the embryo, the endometrium changes and transform into decidua [2, 3].

The chorion is not the same everywhere. The side facing the uterine cavity is deprived of primary villi and is represented mainly by cytotrophoblast. This is a smooth chorion. The side facing the myometrium, on the contrary, has a developed syncytiotrophoblast and forms numerous intertwining secondary villi. They differ from the primary ones in that, in addition to the trophoblastic epithelium, they also include the underlying mesoderm (connective tissue). At the beginning of the 4th week, umbilical vessels begin to grow into the amniotic leg from the body of the embryo and grow in the wall of the trophoblast and its villi. Villi with vessels are classified as tertiary. This part of the chorion is called the branched chorion. It is he who is involved in the formation of the placenta. It has a discoid shape, so the human placenta is of the discoidal type [1].

## PLACENTA

Changes in the endometrium during implantation consist in the transformation of the mucous membrane into decidual tissue. With the endometrium, changes occur corresponding to the secretory phase of the ovarian-menstrual cycle, i.e. loosening and swelling, accumulation of secretions in the ducts of the uterine glands, the transformation of fibroblasts into decidual cells (see above). By day 5-8, this process extends to the entire endometrium, which turns into a decidual (or falling off) membrane. This shell around the embryo is not the same. One part of it – the main or **decidua basalis**, which is located between the villous chorion and myometrium – grows the most and is part of the placenta [2].

Two others:

– **decidua capsularis**, which covers the embryo from above, i.e. lies between the fetal bladder and the uterine cavity;

– **decidua parietalis** (or parietal) lines the wall of the uterine cavity, without touching the fetal bladder.

In the decidua capsularis atrophic changes begin from the end of the second month; in the future, the fetal bladder presses it against the parietal membrane, forcing them to unite. Thus, the cavity inside the uterus disappears, and these two falling membranes are added to the composition of the amniotic sac [3].

## The parts of placenta

1. Fetal part, which develop from chorion
2. Maternal part, which develop from decidua basalis

The one strongly branching tertiary chorionic villas is called *cotyledon*.

Cotyledons begin to take shape by the 50th day and complete their formation by the 4th month. In total, the placenta contains 10-12 large and 40-50 small cotyledons.

The **fetal part of the placenta** is divided into 10 to 38 cotyledons at the 4<sup>th</sup> – 5<sup>th</sup> month of the pregnancy.

**Material part of the placenta** represented by the basal plate, connective tissue septa and lacunae with maternal blood.

The basal lamina is represented by fibrous connective tissue; its cells begin to differentiate into decidual cells. These are large, glycogen-rich cells with clear boundaries, rounded nuclei and oxyphilic cytoplasm. The functions of decidual cells are as follows: 1) limit the growth of the trophoblast; 2) take part in the formation of fibrinoid; 3) some of these cells are endocrine, producing prostaglandins and lactotropic hormone; 4) they produce substances such as thromboplastin. 5) have a suppressive effect on maternal immunocompetent cells.

An amorphous substance (Rohr's fibrinoid) is located on the surface of the basal plate facing the chorionic villi. The trophoblastic cells of the basal lamina, together with fibrinoid, play an essential role in ensuring immunological homeostasis in the mother-fetus system [1].

The human placenta belong to the **hemochorial type** because the fetal part or chorion is directly in contact with the maternal blood.

The fetal blood and the maternal blood do not mix because between them there is a placental barrier [1 – 3].

### **Placental barrier**

1. The endothelium of the capillaries
2. The basal lamina of this capillaries
3. The mesenchyme of the villas
4. The basal lamina of the trophoblast
5. The cytotrophoblast and syncytiotrophoblast during the first half of pregnancy and only syncytiotrophoblast in the second half of pregnancy [1].

### **The functions of placenta:**

1. Placenta is provided the nourishment of the embryo.
2. Placenta is provided the exchange of gases and metabolic products between the fetal and the maternal blood.
3. Placenta is provided the protection of the embryo from immunologic attack by the maternal organism.
4. Placenta is the endocrine organ, producing hormones such as chorionic gonadotropin, human placental lactogen, chorionic thyrotropin, chorionic corticotrophin, estrogens and progesterone [1, 4].

### **REFERENCES**

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