MINISTRY OF HEALTH OF UKRAINE

ODESA NATIONAL MEDICAL UNIVERSITY

Faculty of **Dentistry**

Department of **Histology, Cytology, Embryology and Pathological Morphology with a course in Forensic Medicine**

APPROVED

Vice-rector for scientific and pedagogical work

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September 4, 2023

METHODOLOGICAL RECOMMENDATION FOR PRACTICAL CLASSES FROM EDUCATIONAL DISCIPLINE

Faculty of Dentistry, course 1

Educational discipline - **"Histology, cytology and embryology."**

Approved:

At the meeting of the Department of Histology, Cytology, Embryology and Pathological Morphology with the course of Forensic Medicine of Odesa National Medical University

Protocol No. 1 of September 1, 2023

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Practical lesson №1

Topic: Introduction to histology, cytology and embryology. Microscope, microscopic devices. Histological technique

Objective: Histology, cytology and embryology provide, together with fundamental disciplines, the opportunity to study theoretical and clinical pathology. The main objects of study of histology are histological preparations and electron microphotographs. The main method of research is microscopy. Histological examination of biological tissues is widely used in the practice of a laboratory doctor, pathologist, forensic physician. The data of morphological research are an important component of information in the practice of a doctor of any specialty.

The development of histology as a science and its further progress are inextricably linked with the improvement of research methods. Histology has a large arsenal of tools for studying biological structures at all levels of their organization: cellular, tissue, organ. Research methods used in histology are necessary for a doctor of any profile for the diagnosis, treatment and prevention of diseases, knowledge of the causes of diseases and complications of their course.

The introduction of the latest research methods leads to the rapid development of biological sciences, including histology, and ensures its widespread introduction into clinical disciplines.

Basic concepts:

According to the graph of the logical structure of the topic (Appendix 1), while studying the methods of microscopy, find out the limits of light microscopy, which are limited by the wavelength of light. This will allow you to understand the purpose of creating microscopes using shorter wavelengths (ultraviolet, fluorescent, electron). Special methods of microscopy include:

a) dark field microscopy - allows in the unstained preparation to isolate the con-

trusting structures;

b) phase-contrast microscopy allows to examine living and non-stained objects,

that are contrasting and different in terms of light refraction;

c) polarization microscopy provides detection of unstained anisotropic

structures (collagen fibers, myofibrils, etc.);

d) fluorescence microscopy is used to observe fluorescent objects and allows to detect the chemical composition of objects (nucleic acids, proteins, carbohydrates, lipids);

e) ultraviolet microscopy makes it possible to study the chemical composition of the histo

logical structures, to study objects in a living organism.

Studying the electron microscope, it is necessary to find out the principle of operation of the microscope, to remember the resolution of the transmission electron microscope (0.002 nm),

which allows you to study cells and intracellular structures. To obtain a three-dimensional image of the object under study, a scanning electron microscope is used. It allows to study the structure of the surface of cell membranes using the method of chipping (freezing-chipping).

Histochemical methods are used to determine the chemical composition of structures and metabolism of cells, tissues and organs. The localization of the substance under study is determined by the stained reaction product. Histochemical methods are used to detect: enzymes, nucleic acids, carbohydrates, fats. A variety of histochemical methods is the immunohistochemical method, which allows to detect tissue antigens using labeled antibodies. The method of cell and tissue culture is used to study their function outside the influence of regulatory mechanisms of the whole organism.

When studying histological technique, it is necessary to find out the tasks and principles of fixation, types and features of fixatives, the main stages of making histological objects, dehydration, pouring into paraffin or celluloid, preparation of blocks, sections, staining of preparations (sections) and their conclusion, the principle of staining with hematoxylin and eosin.

To study the rules of working with a microscope, it is advisable to use a liver preparation in which the boundaries of cells and nuclei are well distinguished. When considering the structure and principle of operation of a light microscope, as well as the rules for using it, you should be able to name and show the main parts of an optical microscope. Memorize the rules for using the microscope (Appendix 2). Directly at your workplace master the skills of using a light microscope.

Appendix 2. Rules of work with a light microscope.

1. Place the microscope in front of you.

2. Check the position of the small objective (it is necessary to center the objective and set the tube so that the front lens of the small magnification objective remains at a distance of 1-1.5 cm from the surface of the slide).

3. Illuminate the field of view with a mirror or portable light source.

4. Place the slide on the slide with the cover slide up so that the object to be examined is in the center of the slide.

5. To find the image at low magnification, it is necessary to change the position of the tube using the macro screw, bringing the front lens of the low magnification lens closer to the cover glass at a distance of about 1 cm.

6. When switching to high magnification, fix the tripod leg with the left hand, and slightly raise the barrel by 1-2 mm with the right hand, turning the macro screw towards you by ¼ turn, then turn the turret clockwise until the lock clicks. Using the macro screw, slowly lower the tube to a distance of 0.2 cm between the lens of the high magnification objective and the cover glass.

7. When examining the specimen at high magnification, use a microscrew, rotating it towards and away from yourself no more than half a turn, which allows you to examine the depth of the specimen.

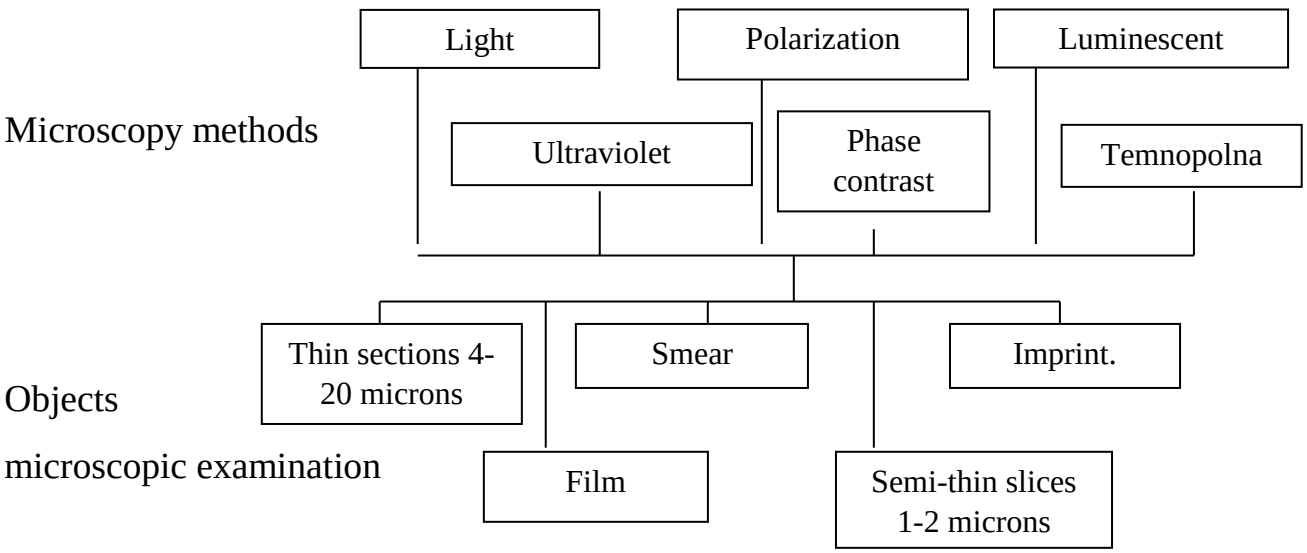
8. To remove the specimen, it is necessary to switch the microscope to low magnification at the shortest distance until the latch clicks, remove the specimen from the slide.

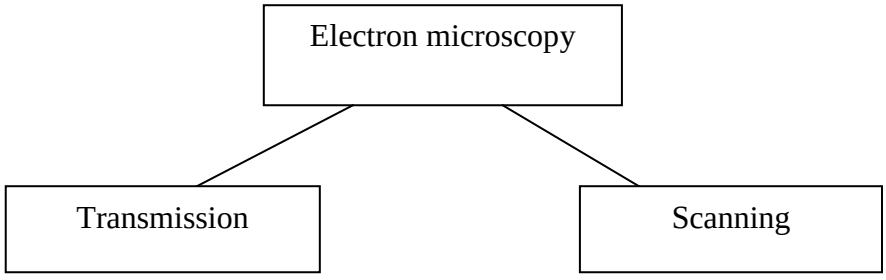
9. Bring the microscope to its original position.

Appendix 3. Main stages of histological preparations manufacturing:

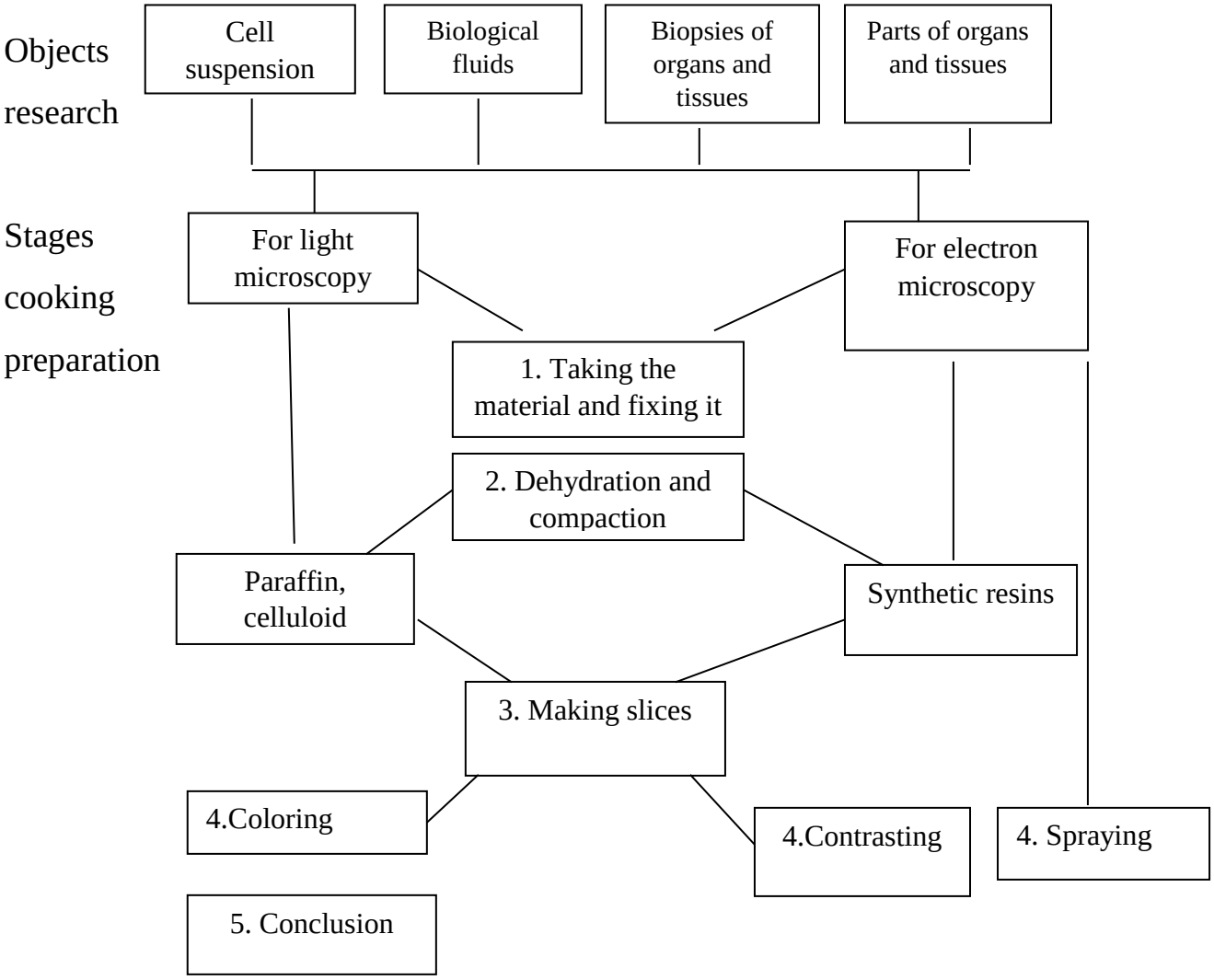
1. Obtaining material (0.5-2cm). 2. Fixation of the material (preservation of tissue structures, organ) a) simple fixatives (formalin solutions, alcohols: ethyl, methyl, acids: acetic, picric, osmic) b) complex fixatives (fixing mixtures that include the above components in different ratios). 3. Dehydration of the fixed material (alcohols of different concentrations, gradually increasing from 50-70° to 100°. 4. Sealing of the object (carried out in paraffin, celluloid, synthetic resins). 5. Filling the material (paraffin, celluloid, epoxy resins). 6. Making sections (thin (5-7 microns), semi-thin (0.5-1 microns) for light microscopy and ultrathin for electron microscopy (0.05-0.2 microns). 7. Staining of preparations with the use of histological dyes. 8. Classification of histological dyes: a) by origin: vegetable (hematoxylin), animal (carmine), synthetic (eosin, azure, fuchsin); b) by chemical properties (acidic, basic and neutral). 9. Use of other types of histological preparations (smears, prints, films, total preparations). 10. Vital, supravital and postvital methods of research.

Graph logical structure of the lesson





Methods



Equipment: slides**,** histological micro-sections, microscope, electronograms.

The plan:

Technological map of the lesson for full-time training

	Stages	Hour	Means of training	Equipment	Venue.
1	Greetings. Checking the attendees	5		Progress log	Study room
2	Checking the baseline	15	Test questions, situational tasks		
3	Correction of assimilation of theoretical material	20		Tables, slides, micro preparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Drawing up a protocol of practical training.	20	Atlas with microdrugs and EG	Microscope, micro preparations, album	
6	Analysis of the results. Summing up the results	15	Checking the practical part of the lesson		

Technological map of the lesson for online learning

	Stages	Hour	Means of	Equipment	Venue.

			training		
1	Greetings. Checking the attendees	3		Progress log	Study room
2	Checking the baseline	15	Test questions, situational tasks		
3	Correction of assimilation of theoretical material	10		Tables, slides, micro preparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Drawing up a protocol of practical training.	15	Atlas with microdrugs and EG	Microscope, micro preparations, album	
6	Analysis of the results. Summing up the results	2	Checking the practical part of the lesson		

Control of the reference level of knowledge:

Basic knowledge, skills, abilities

Discipline of laziness	**To know**	**Be able to**
Physics	The principle of operation of the optical microscope	Mark on the scheme of the optical microscope its main working units
Chemistry	Dye groups for basophilic and oxyphilic structures	Prepare dyes for coloring slices

Control questions

1. Research methods used in modern histology, cytology and embryology.
2. Vital research methods. Cultivation in vivo and in vitro.
3. Basic principles of preparation of preparations for light microscopy.
4. Stages of preparation of permanent histological specimen.
5. Types of micropreparations.
6. General characteristics and classification of histological stains.
7. Histochemical methods of research.
8. The essence of the method of impregnation, decalcification, autoradiography.

Test tasks:

1. For the study of transparent, weakly refracting objects that are not visible when illuminated in the usual way is used:
A. World microscope
B. Dark field microscope
C. Ultraviolet microscope
Д. Electron microscope
E. Polarizing microscope

2. In the study of muscle tissue there is a need to identify iso- and anisotropic structures. What type of microscopy will be used for this purpose?
A. Ultraviolet microscope
B. Fluorescent microscope
C. Polarizing microscope
D. Light microscope
E. Phase contrast microscope

3. The basis for the creation of this microscopic device was the phenomenon of luminescence. What kind of device is it?
A. Light microscope
B. Fluorescent microscope
C. Electron microscope
D. Polarizing microscope
E. Dark-field microscope.

4. The experiment uses living, unpainted objects containing structures that refract light rays differently. What type of microscopy should be used in this case?
A. Electron microscope
B. Polarizing microscope
C. Phase contrast microscope
Д. Ultraviolet microscope
E. Fluorescent microscope.

5. In the study of viruses, a three-dimensional image of the objects under study was obtained. What type of microscopy was used?

A. Electron microscope
B. Polarizing microscope
C. Phase contrast microscope
Д. Ultraviolet microscope
E. Fluorescent microscope.

6. In histological examination it is necessary to study structures whose size ranges from 0.1-0.2 microns. What microscopic instrument should be used?
A. Light microscope
B. Dark field microscope
C. Ultraviolet microscope.
D. Polarizing microscope
E. Phase contrast microscope

7. In the manufacture of histological preparations used phosphors that cause the glow of certain structures. For what microscopy are histological objects intended?
A. Light microscopy
B. Electron microscopy
C. Phase-contrast microscopy
D. Polarization microscopy
E. Fluorescence microscopy

8. The image quality of the object under study is characterized by the clarity of the image and depends on the degree of aberration elimination. How can you reduce the spherical aberration of the image?
A. Using lenses of different curvature
B. Use of lenses of different chemical composition
C. The use of ultraviolet lamps as a light source
E. Use of phosphors
E. Using a higher magnification eyepiece

9. The image quality of the objects under study depends on the degree of aberration correction. How can the chromatic aberration of the image be reduced?
A. Using phosphors
B.Using lenses with different chemical composition
C.Using lenses of different curvature
D. Diaphragmatic aperture
E. Using ultraviolet radiation

10. A microscope is an optical instrument designed to obtain magnified images of biological objects. What part of the microscope creates an image of an object?
A. Ocular
B. Lens
C. Condenser
D. Mirror
E. Cremalier

11. In the experiment, the processes of synthesis of steroid (fatty nature) hormones by the adrenal glands were studied by histological methods. What dye should be used to detect fat inclusions?
A. Picric acid
B. Osmic acid
C. Mucicarmine
D. Orsein
E. Resorcinol-fuchsin

12. In the experiment on the animal studied the state of the elastic frame of the aorta under the influence of various chemical and physical factors. What dye will allow to detect elastic fibers in the histological preparation?
A. Picric acid
B. Osmic acid
C. Mucicarmine
D. Safranin
E. Resorcinol-fuchsin

13. When preparing a permanent histological specimen, sections are dewaxed before staining. What chemical is usually used for this purpose?
A. Ethyl alcohol
B. Xylene
C. Acetic acid
D. Phenol
E. Glutaraldehyde

14. In clinical laboratories, histological examination is used to establish or confirm a diagnosis. Which of the following objects is not a drug?
A. Slices
B. Smears
C. Films
D. Imprints
E. Attachments

15. In clinical laboratories, the study of histological preparations prepared from fixed tissues is used to establish or confirm the diagnosis. What does not belong to fixative fluids?
A. Formalin
B. Celloidin
C. Alcohols
D. Glutaraldehyde
E. Osmium tetraoxide

16. In vivo methods of studying cells and tissues are widely used in experimental medicine. In vivo dyes are used to enhance the contrast of the studied samples. These include:
A. Janus green
V. Azur
C. Eosin

D. Fuchsin acidic
E. Fuchsin basic

17. In vivo methods of studying cells and tissues are widely used in experimental medicine. In vivo dyes are used to enhance the contrast of the studied samples, which must meet the main requirement:
A. To be bactericidal
C. To be non-toxic
C. Quickly penetrate the tissue
D. Selectively communicate
E. Coagulate proteins

18. In forensic and sports medicine, the method of determination of Bara bodies, which is an X-chromosome condensing, occupying a marginal position in the nucleus, or taken out of the nucleus in the form of the so-called "drumstick", is used to establish the floor. What property should a dye that detects these structures have?
A. To be sour
B. To be the main one
C. To be neutral
D. To be alcoholic
E. To be aquatic

19. For the correct choice of tactics of surgery for a tumor, histological analysis of the tumor is carried out immediately. In this case
the method of rapid tissue freezing is used, which is characterized by artifacts. What is the most powerful factor contributing to the appearance of artifacts, i.e. distortions of the vital structure?
A. Lack of chemical fixation
C. No pouring in paraffin wax
C. Formation of ice crystals during freezing
D. Deformation during preparation of slices
E. Deformation during thawing of slices

20. The experiment studied the secretory activity of mucous cells under the influence of physical and chemical factors. What dye will allow to detect these cells on the histological preparation?
A. Carmine Besta
V. Mucicarmine
C. Congo red
D. Janus green
E. Toluidine blue

Situational tasks:

1. The experiment used living objects in which it is necessary to determine a number of chemical components using vital observation. What microscopic method of investigation will be used?

2. In the histological study of the cell used phosphors. What type of microscopy was used in this case?

3. The researcher is tasked with obtaining a spatial representation of the structure of the object under study. What microscopic instrument will the specialist work with?

4. Ultraviolet microscopy 24. Mercury-quartz lamps are used as a light source. What is the resolution of the microscope with this light source?

5. The resolution of a microscope depends on the wavelength of the light source. What is the resolution of a light microscope?

6. Before starting to examine a histological specimen, it is necessary to evenly illuminate the field of view. What parts of the microscope are used for this?

7. Glycogenosis is a group of congenital diseases that develop when a number of enzymes are deficient, resulting in the accumulation of glycogen in tissues. What dye can detect its inclusion in the cytoplasm of cells?

8. The experiment studied the secretory activity of goblet cells under the influence of physical and chemical factors. What does the cytoplasm of these cells look like when stained with common dyes?

9. In an animal experiment the state of the elastic frame of the aorta under the influence of various chemical and physical factors was studied. How will the elastic fibers look on the histological preparation when stained with common dyes?

10. In the study of muscle tissue on the preparation stained with the common dyes hematoxylin and eosin, the muscle and surrounding connective tissue and decalcified bone tissue are stained pink. Which dye should be preferred to selectively stain muscle tissue in a different color?

11. A frequent criterion for determining the state of energy metabolism in a cell - tissue - organ is the assessment of the state of mitochondria. What dye selectively binds to this organelle, making them available for study at the light-optical level?

12. Some thyroid diseases are characterized by iodine metabolism disorders. What method should the researcher choose to trace the stages of iodine absorption from the blood, its inclusion in the synthesis of hormones, further accumulation and excretion as part of hormones in the blood?

13. Impregnation is a common method of classical histology based on the deposition of heavy metal salts on certain structures. Which of the following structures will not be detected by this method?

14. Bone is a highly mineralized tissue, not subject to cutting on a microtome? What method will allow to study this tissue on a histological preparation?

15. In order to study the phagocytic activity of macrophages, dye particles are injected into a living organism, which are actively captured by macrophages and thus mark them, which allows further identification of these cells on the preparation. What is this method called?

16. One of the methods that allow studying the patterns of embryo development is that a fertilized egg is transplanted into the fluid of the anterior chamber of the eye of an experimental animal and, using the transparency of the cornea, the early stages of embryogenesis are observed. What is this method called?

Control materials for the final stage:

Tests:

1. The effect of a drug on cell motility is being studied. Which of the following methods allows to observe the movement of cells?
A. Impregnation
B. Decalcification
C. Cultivation
D. Autoradiography
E. Cytophotometry

2. Congenital metabolic disorders are characterized by the accumulation of certain compounds in the patient's tissues. In particular, in Marfan syndrome there is an accumulation of glycosaminoglycans in the connective tissue. Which of the following methods will determine the amount of substance on the tissue section?
A. Impregnation
B. Decalcification
C. Cultivation
D. Autoradiography
E. Cytophotospectrometry

3. In the diagnostic laboratory, during the study of a red bone marrow punctate, erythrocytic cells with a pronounced basophilia of the cytoplasm were found. What can be the reason for this phenomenon?
A. Protein concentration
B. The presence of the Golgi complex
C. Presence of lipid inclusions
D. High levels of glycosaminoglycans
E. High level of RNA

4. The in vitro cultivation method is used to study the response of isolated living cells to the action of a drug under development. Which of the following conditions does not require strict observance?

A. Temperature regime
B. Sterility
C. Lighting mode
D. Nutrient medium
E. Periodic passages

4. Many diseases associated with metabolic disorders are accompanied by excessive accumulation of certain compounds in body tissues. What method detects the presence and topography of this chemical compound at the cellular and tissue levels?

A. Morphometric
B. Autoradiographic
C. Histochemical
D. Decalcification
E. Impregnation

5. Marfan syndrome is characterized by impaired metabolism of connective tissue glycosaminoglycans, which leads to their accumulation in the body. What histological method can detect these compounds on a tissue section?

A. Impregnation with silver
B. Reaction of metachromasia
C. Felgen's reaction
D. Resorcin-fuchsin staining
E. Schmorl staining

6. To diagnose chromosomal diseases, the human karyotype is examined in the metaphase of mitosis, when the structure of chromosomes is most clearly visible. What dye should be used to detect chromosome rich material?

A. Osmic acid
B. Picric acid
C. Iron hematoxylin
D. Acid fuchsin
E. Carmine Besta

7. To confirm the clinical diagnosis of a malignant tumor in a patient during surgery, material was taken for histological rapid diagnosis. What material in this case is used as a sealing medium?

A. Paraffin
B. Celoidin
C. Epoxy resin
D. Ice
E. Canadian balsam

8. To confirm the clinical diagnosis of malignant tumor in a patient during surgery was taken material for histological rapid diagnosis. What device is used for preparation of sections in this case?
A. Rotary microtome
B. Sledge microtome
C. Ultramicrotome
D. Cryostat
E. Vibrot

9. One of the criteria for assessing the morphofunctional state of the nerve cell is the state of the "chromatophilic substance", which is a granular EPS at the electron microscopic level. What dye will allow to detect these structures at the light-optical level?
A. Alkaline
V. Sour
C. Neutral
D. Lifetime
E. Special

10. The method of tissue or organ culture is often used to study the mechanisms of embryonic differentiation and morphogenesis. In this case, to increase the intensity of proliferative processes, the nutrient medium should contain:
A. Nucleic acids
B. Amino acids
C. Glucose
D. Embryonic extract
E. Blood plasma

11. In the study of histological material it is necessary to study the structure, the size of 0.1-0.7 nm. What microscopy should be used to study these structures?
A. Light microscopy
B. Electron microscopy
C. Ultraviolet microscopy
D. Polarization microscopy
E. Fluorescence microscopy.

12. A histological specimen is made using quartz coverslips and slides. For what microscopy was the micro specimen prepared?
A. Light microscopy
B. Electron microscopy
C. Ultraviolet microscopy
D. Polarization microscopy
E. Dark field microscopy

13. In the study of histological material it is necessary to determine the linear dimensions of microscopic objects. What microscopic device should be used?
A. Microspectrophotometer
B. Micrometer

C. Light microscope
D. Micromanipulator
E. Microphotocamera.

14. The resolution of the microscope is characterized by the ability of the lenses to give a resolution image of the smallest details of the object. What does the resolution limit depend on?
A. The presence of a condenser
B. Wavelengths of the light source
C. The presence of chromatic aberration
E. Presence of spherical aberration
E. Magnification of the microscope.

15. The image quality of a histological object depends on the degree of correction of optical imperfections of the lenses. Which characteristic does not affect the image quality?
A. Chromatic aberration
B. Spherical aberration
C. Astigmatism
D. Distortion
E. Wavelength of the light source

16. Lens - the optical part of the microscope that creates an image of the object under study. What lenses are not used in light microscopy?
A. Dry air
B. Immersive
C. Achromatic
D. Apochromatic
E. Electromagnetic

17. It is necessary to study the ultramicroscopic structure of an organelle involved in protein biosynthesis. What type of microscopy should be used?
A. Light microscopy
B. Electron microscopy
C. Ultraviolet microscopy
D. Polarization microscopy
E. Dark-field microscopy.

18. The microscope consists of optical and mechanical parts. What are the optical parts?
A. Tube, eyepiece, condenser
B. Revolver, macro and micro screw, mirror
C. Revolver, eyepiece
E. Ocular, condenser, lens
E. Tube, eyepiece, revolver

19. When using ultraviolet rays as a light source, the resolving power of a microscope increases. What microscopic instruments use this light source?
A. Dark field and luminescent

B. Luminescent, ultraviolet
C. Light electronic
E. Phase-contrast, ultraviolet
E.Polarization, ultraviolet

20. A microscope consists of mechanical and optical parts. Which parts of the microscope have an aperture?
A. Ocular and lens
B. Ocular and condenser
C. Tube and eyepiece
E. Lens and condenser
E. Tube, lens, eyepiece

Situational tasks:

1. The researcher is tasked to study the ultramicroscopic structure of the erythrocyte plasmolemma. What microscopic device will be used?

2. In the study of skeletal muscle tissue it is necessary to determine the iso- and anisotropic structures of the tissue. What type of microscopy will be used?

3. The resolution of a fluorescent microscope depends on the wavelength of the light source. Why is it equal?

4. In a clinical laboratory, microscopic examination is used to study a complete blood count. What microscope is needed for this?

5. A living object with natural luminescence is presented for study. What type of microscopy should be used in this study?

6. As a result of biopsy, tumor cell material is obtained. It is necessary to study their ultramicroscopic structure. What type of microscopy is used in this study?

7. A patient diagnosed with macrocytic anemia has large red blood cells in peripheral blood. What histological method allows to measure the diameter of red blood cells in a blood smear?

8. To study the mechanisms of bone matrix liming, the experimental animal was injected with 32P radioactive phosphorus solution. After some time, histological sections were made from the bone taken from the animal. What histological method will allow to determine the inclusion of 32P in bone tissue?

9. To study nucleic acids on a liver section, the researcher used a histochemical method that allowed to simultaneously detect RNA in the form of red staining of the cytoplasm, and DNA - in the form of green staining of the nucleus. What dye was used?

10. As a result of cyanobalamin and folic acid deficiency, a patient developed pernicious megaloblastic anemia, characterized by impaired DNA synthesis in erythroid cells. What histochemical method should be used for selective detection of DNA?

11. In the experiment, the activity of RNA polymerase enzyme responsible for mRNA transcription in the nucleus was inhibited. Accordingly, the amount of rRNA and tRNA in the cytoplasm also decreases. What histochemical method allows to detect the presence of RNA in the cytoplasm?

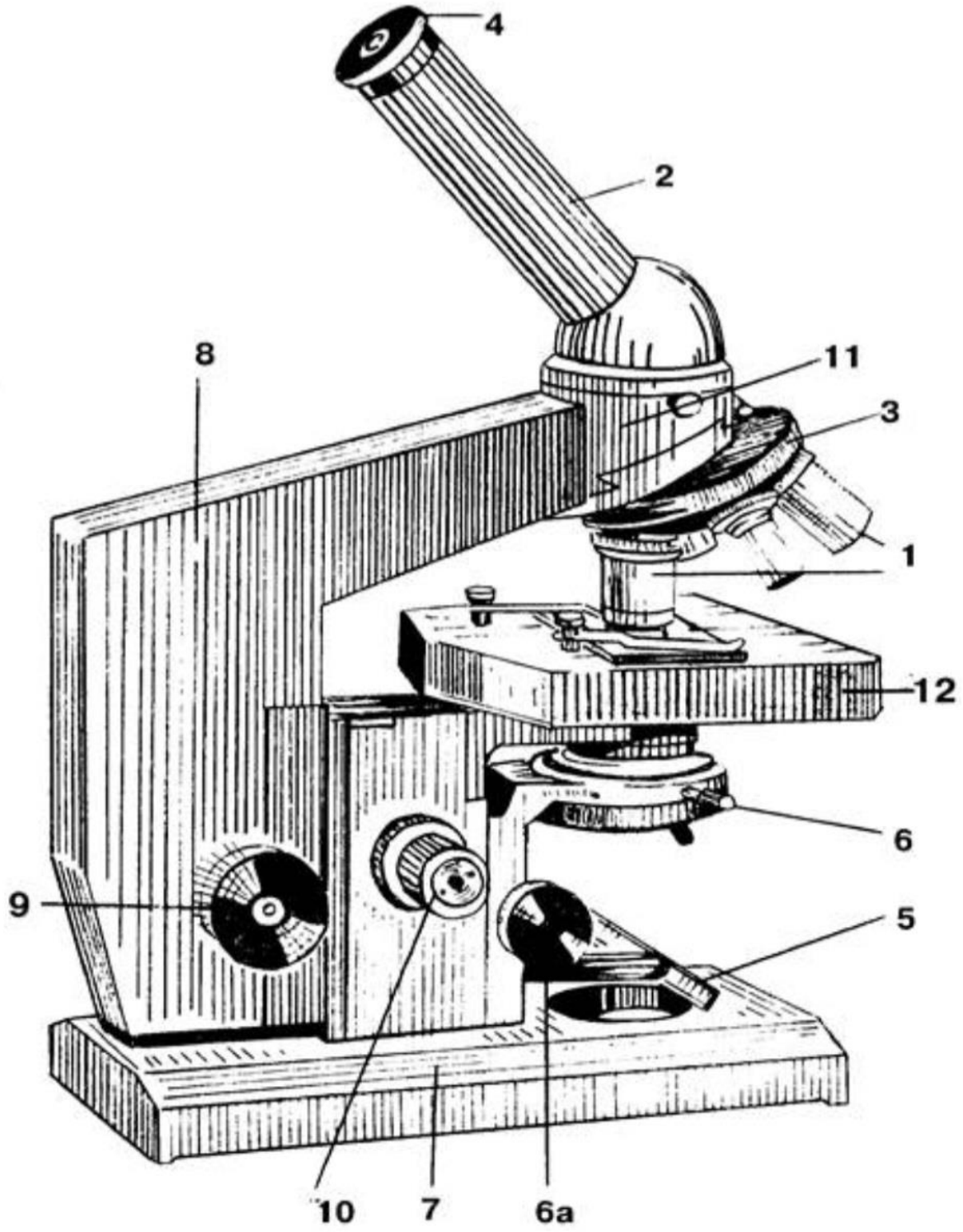
12. Hirschsprung's disease is characterized by impaired neuromuscular transmission due to the lack of the enzyme acetylcholinesterase. What method is used to determine enzymes on tissue sections?

13. Hirschsprung disease, a congenital anomaly of the large intestine, is characterized by impaired neuromuscular transmission due to the lack of the enzyme acetylcholinesterase. When preparing material for the determination of enzymes on tissue sections, all procedures are performed except:

14. Many scientific studies use blood stem cells (BSCs) taken from umbilical cord blood. However, pluripotent stem cells morphologically resemble a small lymphocyte and can be identified only by a set of antigens on the cell surface. What is the name of this method?

15. Preparation of tissues or organs taken for histological examination requires fixation of the material, i.e. preservation of its vital structure. What property of the fixative mainly causes this effect?

Tasks for the formation of practical skills and abilities:



Summing up the results:

The structure of the current assessment in the practical class:

1. Evaluation of theoretical knowledge on the topic of the lesson:
- methods: surveys, solving situational problems and test tasks;
- maximum grade - 5, minimum grade - 3, unsatisfactory grade - 2.

2. Assessment of practical skills and keeping a practical notebook on the topic of the lesson:

- Methods: assessment of the correctness of filling in the practical workbook (tables and figures)
- maximum grade - 5, minimum grade - 3, unsatisfactory grade - 2;

Criteria for the current assessment in the practical class:

"5"	The student is fluent in the material, takes an active part in discussing and solving situational and test problems, confidently demonstrates practical skills in working with micro preparations, expresses his opinion on the topic of the lesson, demonstrates basic knowledge.
"4"	The student has a good command of the material, participates in the discussion and solution of situational and test problems, demonstrates practical skills in working with microdrugs with some mistakes, expresses his opinion on the topic of the lesson, demonstrates basic knowledge.
"3"	The student has insufficient knowledge of the material, hesitantly participates in the discussion and solution of situational and test problems, demonstrates practical skills when working with micro preparations and electronograms.
"2"	The student does not know the material, does not participate in the discussion and solution of situational and test problems, does not demonstrate practical skills when working with micro preparations and electronograms.

List of recommended literature .

The main one:

1. Lutsyk O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New Book, 2018.
2. Barinov E.F., Tchaikovsky Y.B. General histology and embryology of internal organs: textbook.Kyiv: Medicine; 2013
3. Wojciech Pawlina. Histology: textbook and atlas. WSV: Medicine, 2021.

Additional:

1. Histology and embryology of internal organs: textbook / E.F. Barinov, Y.B. Tchaikovsky, O.M. Sulaeva et al.
2. Cytology of human organs and tissues edited by L.S.Bolgova. Kyiv: Book-plus, 2018, p.288

METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, dentistry course I course

Academic discipline histology, cytology and embryology

Approved:

Meeting of the Department of Histology,

cytology and embryology

Odesa National Medical University

Minutes No. ___ of "___" _____ 20__ p.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

Practical lesson №2

Topic: Cytology. General organization of the cell. Plasmolemma. Intercellular contacts. Cytoplasm. Metabolism of the cell. Synthetic apparatus of the cell. The system of catabolism.

Purpose:

A cell (cellula) is an elementary living unit of an organism, which is separated from the environment by an active membrane and represents a structurally ordered system of biopolymers that make up the nucleus, cytoplasm, as well as other subcellular components (organelles and inclusions) and participates in a single set of metabolic processes aimed at ensuring the maintenance and restoration of the system as a whole. Biochemical, structural and functional changes in cells are the basis for the development of pathological processes (hereditary diseases, inflammation, dystrophy, tumors, etc.). Therefore, in clinical practice, morphological evaluation of blood cells, vaginal, buccal, bronchial epithelium cells, organ biopsies, etc. is widely used to clarify the diagnosis.

An important role in maintaining the vital activity of the cell is played by the plasma membrane, which performs protective, integrative functions, provides metabolism and regulation of intracellular homeostasis, determines the shape of the cell and its ability to migrate. Disorders of the structure and function of the plasma membrane underlie various pathological processes (insulin-independent diabetes mellitus, vesicular disease, hypercholesterolemia and many others).

In the cytoplasm, most metabolic processes are carried out, providing specific functions of cells, and at the same time the vital activity of the whole organism.

Disturbances in the metabolism and structure of hyaloplasm and organelles, changes in the quantitative and qualitative characteristics of inclusions can reflect the disturbance of various processes and appear as a morphological diagnostic criterion for certain pathological processes.

Basic concepts:

General plan of the eukaryotic cell structure

Eukaryotic cell consists of three main parts: nucleus, cytoplasm and membrane. The **cytoplasm** is separated from the external environment or from neighboring cells by the **cell membrane (plasma membrane). The** cytoplasm, in turn, consists of hyaloplasm and organized structures, which include **organelles and inclusions. The nucleus** has a **shell, karyoplasm,** chromatin (chromosomes), nucleus**.** All these components of the cell, interacting with each other, perform functions necessary for the existence of the cell as a whole. The shape of human cells is very diverse. It can be cubic, cylindrical, polyhedral, flat, spherical, spindle-shaped, prismatic, pyramidal, star-shaped, with processes, etc. The size of cells in the human body varies widely - from 4-5 to 130-150 microns. Examples of the smallest cells are small lymphocytes (blood cells) and cerebellar granule cells. The largest cell bodies are female germ cells and giant pyramidal cells of the cerebral cortex. There are about 200 different types of cells in the human body.

Structure of the cell membrane and its functions

Cell membrane *(plasmolemma).* The elements of the cell membrane are: the glycocalyx, the inner plate - the submembrane or cortical layer of the cytoplasm and the biological membrane itself, to describe the properties of which the liquid mosaic model is used. The main functions of the plasma membrane include: separation of the internal contents of the cell from its microenvironment, transport of metabolites, paramembrane metabolism, reception of signals from the external environment, ensuring mutual recognition and interaction of cells with the formation of intercellular contacts of varying degrees of complexity, secretion and excretion.
The structure of the **biological membrane:** phospholipid molecules, contacting with their hydrophobic ends and repelling hydrophilic ends, form a continuous double lipid bilayer, which is partially or completely buried by protein molecules (mainly glycoproteins). The position of protein molecules is not strictly limited - depending on the functional state of the cell, their mutual movement in the plane of the bilipid bilayer can occur. This variability and mosaic-like topography of macromolecular complexes of the cell surface gave the name to the fluid mosaic model of the biological membrane. Protein molecules that permeate the entire thickness of the bilipid bilayer or are largely embedded in it are called **integral proteins**; the same proteins that are located only on the surface of lipids are called **peripheral** or adsorbed proteins. There is a certain specialization among plasma proteins: there are structural, enzymatic, transport, receptor molecules. The carbohydrate components of glycoprotein and glycolipid molecules of the plasma membrane, protruding above the outer surface of the cell membrane, form the so-called supramembrane zone, or glycocalyx. Oligosaccharide chains of the glycocalyx are a kind of "visiting card" of the cell. With their participation, mutual recognition of cells and interaction with the microenvironment is carried out. Each type of cell has a special sequence of monosaccharide residues in the surface oligosaccharide chains of glycopolymers, its own unique set and cytotopography of carbohydrate determinants.

The principle of structure of non-cellular structures

In addition to cells, a multicellular organism is built of so-called **non-cellular structures,** which are always secondary to cells, i.e. their derivatives. Among non-cellular structures, there are nuclear structures, which contain nuclei and arise by fusion of cells or as a result of their incomplete division, and non-nuclear structures, which are the product of certain types of cells. Nuclear **non-cellular structures** include symplasts and syncytia. **Symplast is a** non-cellular structure, which is a mass of undivided cytoplasm with a large number of nuclei. Skeletal muscle fibers and the outer layer of the germinal part of the placenta have a symplastic structure. **Syncytium,** or bundle (cell mesh, reticular symplast) is a group of cells that are connected into a single whole by cytoplasmic bridges. **Non-nuclear non-cellular structures** include **fibers and the basic (amorphous) substance of** connective tissue, which are produced by one type of cell - fibroblasts. Analogues of the basic substance are blood plasma and liquid part of lymph.
Characteristics of complementary and mutually opposite functions of the plasma membrane Separation and transport are two mutually opposite and complementary functions of the plasma membrane. Thanks to the separation from the external environment, the cell retains its individuality, thanks to the transport of substances it can live and function. Both of these processes are aimed at maintaining the constant characteristics of the internal

environment (homeostasis) of the cell. Transport from the external environment into the cell (uptake of substances) is called **endocytosis,** transport in the opposite direction (excretion of substances) is called **exocytosis.** Small molecules can get from the external environment into the cell either by diffusion (passive transport) or with the participation of special enzymes - **plasma permeases** (active transport).

Mechanisms of molecules entry into the cell

Large molecules and clusters of molecules are absorbed by the cell by wrapping them in a certain area of the plasma membrane with subsequent retraction of the formed sac into the cytoplasm. The process of absorption of solid particles in this way is called **phagocytosis,** absorption of liquid particles - **pinocytosis.** Absorbed particles are usually broken down and their chemical components are absorbed by the cell. Sometimes a particle is absorbed by one cell surface, surrounded by a biomembrane, passes through the cytoplasm and is excreted unchanged on the opposite cell surface. This phenomenon is called **transcytosis.**

Mechanisms of excretion of substances from the cell:

The removal of waste products by the cell outside the cytoplasm (exocytosis) is divided into a number of types: secretion, excretion, recreation, clasmatosis. **Secretion** is the release by the cell of products of its synthetic activity, which are necessary for the normal functioning of organs and systems of the body. **Excretion is the** release of toxic or harmful metabolic products that are subject to excretion outside the body. **Recreation** is the removal from cells of substances that do not change their chemical structure in the process of intracellular metabolism (water, mineral salts). **Clasmatosis** - removal outside the cell of its individual structural components.

Intercellular contacts

The cell membrane, in particular the carbohydrate determinants of its glycocalyx, plays a decisive role in the formation of stable contacts between cells. The simplest form of intercellular communication is **called adhesion** (sticking, sticking together). Recently, the crucial role of specific protein molecules: lectins, cadherins and cell adhesion molecules, in the formation of multicellular conglomerates has been revealed. Lectin molecules, in particular, are able to selectively "recognize" hydrocarbon determinants on the surface of neighboring cells and ensure the formation of stable intercellular bridges. The distance between the plasmolems of adjacent cells in the zone of simple contact is about 10-20 nm.

Characteristics of a specialized contact - synapse

Synapse is a specialized contact between nerve cells or between a nerve cell and a muscle, in the area of which the nerve impulse is transmitted. The main structural components of the synapse are: presynaptic membrane (a section of the plasma membrane of the nerve cell process from which the signal is received), postsynaptic membrane (a section of the plasma membrane of the cell that receives the signal), synaptic cleft 20-30 nm wide (separating pre- and postsynaptic membranes), synaptic vesicles filled with neurotransmitter. The functioning of synapses provides one-way transmission of information from cell to cell with the help of mediator (chemical mediator).

Characteristics of gap junction (nexus) and tight contacts Gap junction or **nexus** provides direct exchange of molecules between neighboring cells. In the zones of these contacts, which have dimensions from 0.5 to 5 microns, hexagonally arranged particles - conexons with a diameter of 7-8 nm and a channel about 1.5 nm wide in the center. Each conexon consists of six subunits of the protein conectin. The conexons are embedded in the membrane so that they penetrate it through. The channels of two conexons are closed "end to end", resulting in a direct chemical connection between the cytoplasms of neighboring

cells: cells connected by gap junctions can freely exchange small molecules (inorganic ions, sugars, amino acids, nucleotides, vitamins), the mass of which does not exceed 1000-1500 daltons. In this case, a kind of metabolic cooperation of cells is achieved. The next form of contact is with the formation of dense closing plates, or **dense closing contact.** In the area of such contact, the maximum convergence of plasma membranes of neighboring cells occurs. The ends of the integral proteins of the plasma membranes of neighboring cells dock with each other, and the available gap is sealed by calcium ions and fibrils that anastomose. The outer hydrophilic layers and glycocalyx of adjacent plasmoles seem to merge under this condition into one continuous layer 2-3 nm thick. Tight closing contact is characteristic of the lateral surfaces of the apical part of the cells lining the digestive canal and provides complete separation of the intercellular space from the external environment. Tight junctional contacts are observed in all types of epithelium (endothelium, mesothelium, ependyma, intestinal epithelium). Contacts of this type are found between fibroblasts, embryonic cells of ectoderm and mesenchyme, etc. Basally from the closing contact between epithelial cells, adhesion zones are often formed, in which the intercellular gap is filled with transmembrane proteins E-cadherins.

Characteristics of desmosomes and semi-desmosomes

Further strengthening of the bonds between cells is achieved by immobilizing (immobilizing) the surface of the adjacent plasma membrane of the contacting cells (formation of the so-called attachment plates, which are based on the protein desmoplakin), with the help of intermediate filaments and the cortical layer of the cytoplasm. This type of connection between cells is **called desmosomes** and occurs where it is necessary to achieve maximum strength of intercellular connections, for example, in the epithelial tissue of the body surface. The intercellular gap in the area of the desmosome is filled with an electron-dense substance, in which there are special transmembrane fibrillar structures consisting of the protein desmoglein. The ends of the latter molecules are attached to the attachment plates, thereby stabilizing the contact of this type. In places of contact of epithelial cells with the basal membrane, structures called **semidesmosomes are** formed. If the desmosome consists of two, the semidesmosome consists of only one attachment plate. The gap between the epithelial cell and the basement membrane is filled with integrin proteins.

The main components of the **cytoplasm** are hyaloplasm, organelles and inclusions.

Hyaloplasm is the internal environment of the cell. It contains the most important enzymes of metabolism of sugars, nitrogenous bases, amino acids, fatty acids and triglycerides, which are necessary for the cell's own needs. **Organelles** are obligatory, specific in structure formations of the cytoplasm, which perform certain functions, providing various aspects of cell vital activity (EPS, Golgi complex - secretion process, lysosomes - intracellular digestion of organic substances, mitochondria - ATP synthesis, etc.) Violation of the functions and structure of organelles causes a number of diseases (lysosomal accumulation diseases, fixed cilia syndrome, etc.). **Inclusions are** non-permanent components of the cytoplasm, which are deposited substances that support the vital activity of the organism under normal or starvation conditions, or temporarily accumulated substances in the cell. Often inclusions are products of disturbed metabolic processes (protein, fat, carbohydrate dystrophy), which is a pathomorphological diagnostic criterion of a certain pathological process.

Hyaloplasm is the thinnest part of the cytoplasm, which contains organelles and inclusions. In the total volume of cytoplasm hyaloplasm is about 50%. It includes cytosol (water with

inorganic and organic substances dissolved in it) and cytomatrix (trabecular mesh of protein fibers). Hyaloplasm, or cytoplasmic matrix, is the internal environment of the cell. The cytoplasmic matrix looks like a homogeneous, fine-grained substance. Hyaloplasm is a complex colloidal system that includes various biopolymers (proteins, nucleic acids, polysaccharides). The osmotic and buffering properties of the cell are determined by the composition and structure of the hyaloplasm, the main function of which is that this semi-liquid substance unites all cellular structures and provides their chemical interconnection with each other.

Organelles are permanent structures of the cytoplasm that have a certain structure and perform a specialized function. Organelles are divided into microscopic, visible under a light microscope, and submicroscopic, which can be seen only with an electron microscope. According to the presence of biological membrane in organelles they are divided into membrane and non-membrane. **Membrane organelles** include: mitochondria, lysosomes, peroxisomes, endoplasmic reticulum, Golgi complex. **Non-membrane organelles** are ribosomes, microfilaments, microtubules, centrosome (cell center). These organelles are called general purpose organelles because they are present in all types of cells.

General and special purpose bodies

Organelles are permanently present in the cytoplasm structures specialized to perform certain functions in the cell. They are divided into **general organelles and special organelles. General organelles** are present in all cells and are necessary for their vital activity. They include mitochondria, ribosomes, endoplasmic reticulum (ER), Golgi complex, lysosomes, peroxisomes, cell center, cytoskeleton components. **Special organelles** are present only in some cells and provide their specialized functions. They include cilia, flagella, microvilli, myofibrils, acrosome (sperm). Special organelles are formed during cell development as derivatives of general organelles.

The endoplasmic reticulum is a submicroscopic membrane organelle of general purpose, which forms a single intracytoplasmic circulatory system, first described by K. Porter in 1945. The endoplasmic reticulum membrane is in direct contact with the plasma membrane of the cell and with the nucleus membranes. There are agranular (smooth) and granular (rough, granular) endoplasmic reticulum. Agranular endoplasmic reticulum is formed only by the membrane. The granular endoplasmic reticulum is formed by the biomembrane, to which ribosomes are attached from the hyaloplasm. The function of the agranular endoplasmic reticulum is associated with the metabolism of lipids and carbohydrates, detoxification of chemical compounds harmful to the cell, as well as the deposition of calcium ions. The function of the granular endoplasmic reticulum is due to the presence of ribosomes and consists in the biosynthesis of proteins both for the needs of the cell itself and for its excretion outside. In addition to performing metabolic and circulatory functions, the endoplasmic reticulum is the only organelle in which the formation of membrane structures of the cell occurs. The components of the biomembrane synthesized by the granular endoplasmic reticulum can be included in the composition of lysosomal sacs, peroxisomes, elements of the Golgi complex, plasma membrane, nucleus envelope, and can also be used for self-replication of the endoplasmic reticulum elements.

The Golgi complex or lamellar complex is a microscopic membrane organelle of general purpose, in which the process of formation of products of synthetic activity of the cell is completed, in particular, their final glycosylation is carried out. The Golgi complex accumulates secretory substances and ensures their excretion outside the cell. The organelle was named after the Italian histologist Camillo Golgi, who in 1898 described this complex

as part of nerve cells. Morphologically, the lamellar complex is a set of interconnected cisternae, flattened in the central part and dilated on the periphery. Small vesicles are separated from the expanded edges of the cisterns. A separate set of such cisternae and vesicles is called a **diktiosome**. Figuratively, a diktiosome is compared to a stack of plates turned convex side to the nucleus. In one cell there can be several diktiosomes separated from each other by layers of hyaloplasm. The synthesis (maturation) of secretory products is completed during the movement of their cisternae located near the nucleus (so-called cis-localization of cisternae),
direction of plasma membrane (trans-localization of cisternae). Vesicles, which are separated from the edges of the cisterns, contain formed, ready for excretion from the cells secretory products. The macromolecular complexes accumulated in the vesicles are excreted by embedding the vesicle membranes into the plasma membrane or by pushing the formed (mature) vesicles outside the cell.

Lysosomes are submicroscopic membrane organelles of general purpose, discovered in 1955 by Christian de Duve. The main function of lysosomes is to break down biopolymers of different chemical composition (cell digestion). For this purpose, lysosomes contain a set of hydrolytic enzymes (now more than 60 of them are known). The marker (determining) enzyme of lysosomes is acid phosphatase. The enzyme complexes of the lysosome matrix are located in a closed membrane sac, which prevents the lysosomal enzymes from entering the hyaloplasm and prevents the cell from self-digestion. Depending on the ultrastructural and functional features of lysosomes, they are divided into **primary** (whose enzymes are inactive), **secondary**, or phagosomes (activated enzymes in them are in direct contact with degradable biopolymers), as well as **residual** bodies (undegraded residues surrounded by a biomembrane).

Lysosomes can participate both in the breakdown of the cell's own macromolecular complexes (this phenomenon is called **autophagocytosis) and** in the digestion of particles absorbed by the cell **(heterophagocytosis).**

Peroxisomes are submicroscopic membrane organelles of general purpose, discovered in the early 60s of XX century by joint efforts of biochemists and morphologists. Peroxisomes play a crucial role in the processes of cell detoxification (getting rid of toxic metabolic products). The rounded sac formed by the biomembrane is filled with enzymes (matrix), among which catalase is a marker. In the center of the peroxisome matrix, a dense core (crystalloid) containing fibrous and tubular macromolecular formations was found with the help of an electron microscope.

The enzyme systems of peroxisomes are aimed at utilization of chemically active atomic oxygen (primarily by regulating the metabolism and breakdown of hydrogen peroxide), as well as provide the breakdown of ethyl alcohol, uric acid, regulation of lipid metabolism.

Mitochondria are microscopic membrane organelles of general purpose, the main function of which is the formation of energy necessary for the life of the cell and its accumulation in the composition of adenosine triphosphoric acid (ATP) molecules. In addition, mitochondria are involved in the regulation of water metabolism, calcium ion deposition, production of steroid hormone precursors. Mitochondria were discovered by the German researcher F. Altman in the late XIX century. Under a light microscope, mitochondria look like small dots and threads. With the help of an electron microscope, two membranes can be distinguished in each mitochondrion, which has an irregular oval or elongated shape: the outer smooth and the inner folded membrane, which forms outgrowths (cristae) inside the mitochondrion. The inner content of the mitochondrion is an electron-dense substance called the matrix. In

the matrix, as well as on the inner membrane of mitochondria, there are proteins-enzymes that provide ATP synthesis by oxidative phosphorylation of adenosine diphosphate (ADP). Mitochondria are the only organelles in the cell that contain molecules of their own deoxyribonucleic acid (DNA); their matrix also includes various types of RNA and ribosomes.

Ribosomes are submicroscopic non-membrane organelles of general purpose, in which amino acids are combined to form a peptide chain, i.e. protein molecules are synthesized. Ribosomes as part of the granular endoplasmic reticulum were first described by J. Palade. Morphologically, there are two subunits in ribosomes, their combination forms a structure that resembles a mushroom in shape. From a chemical point of view, a ribosome is a ribonucleoprotein complex of ribosomal RNA and protein in a ratio of 1:1. In case of exposure to damaging factors or disruption of electrolyte homeostasis of the cell (lack of magnesium ions), the ribosome breaks down into subunits (disaggregation), and its biological activity is lost. Several ribosomes "strung" on a common strand of information RNA are called **polysomes**. Polysomes suspended in the hyaloplasm synthesize proteins mainly for the internal needs of the cell. Polysomes associated with the membranes of the endoplasmic reticulum mainly synthesize proteins for export outside the cell.

Microfilaments are submicroscopic non-membranous general-purpose organelles that act as the cytoskeleton and contractile apparatus of the cell. Microfilaments are thin fibers built of actin (thin filaments, diameter about 5 nm), myosin (thick filaments, diameter about 25 nm), tropomyosin or alpha-actinin proteins. They are located mainly in the cortical (submembrane) zone of the cell and as part of its cytoplasmic outgrowths. Their function is contractile-motor. The so-called intermediate microfilaments have a diameter of 10-15 nm. Protein, from which intermediate filaments are built, is a very specific feature of a particular cell type. For example, keratin serves as a histochemical marker of epithelial cells, vimentin - connective tissue, desmin - muscle, neurofilament protein and glial fibrillary protein - nervous tissue. Intermediate microfilaments are mainly responsible for maintaining the cell shape.

Microtubules are submicroscopic non-membrane organelles of general purpose, the main function of which is to ensure the mobility of cellular organelles, as well as the formation of the cytoskeleton. Microtubules are built of globular tubulin proteins, whose molecules are capable of polymerization. In a special way "strung" on each other, individual molecules form a kind of "beads". 13 threads of "beads", which are placed in parallel, form a hollow cylinder. The wall thickness of the cylinder corresponds to the diameter of one tubulin molecule. Polymerization of tubulin molecules is a dynamic process that stops under the influence of adverse environmental factors (lowering the temperature, treatment with colchicine). Partial depolymerization of microtubules leads to their shortening, complete - to the disintegration (dissociation) into individual tubulin molecules. Microtubules are the basis of the centrosome structure, as well as structures such as cilia and flagella.

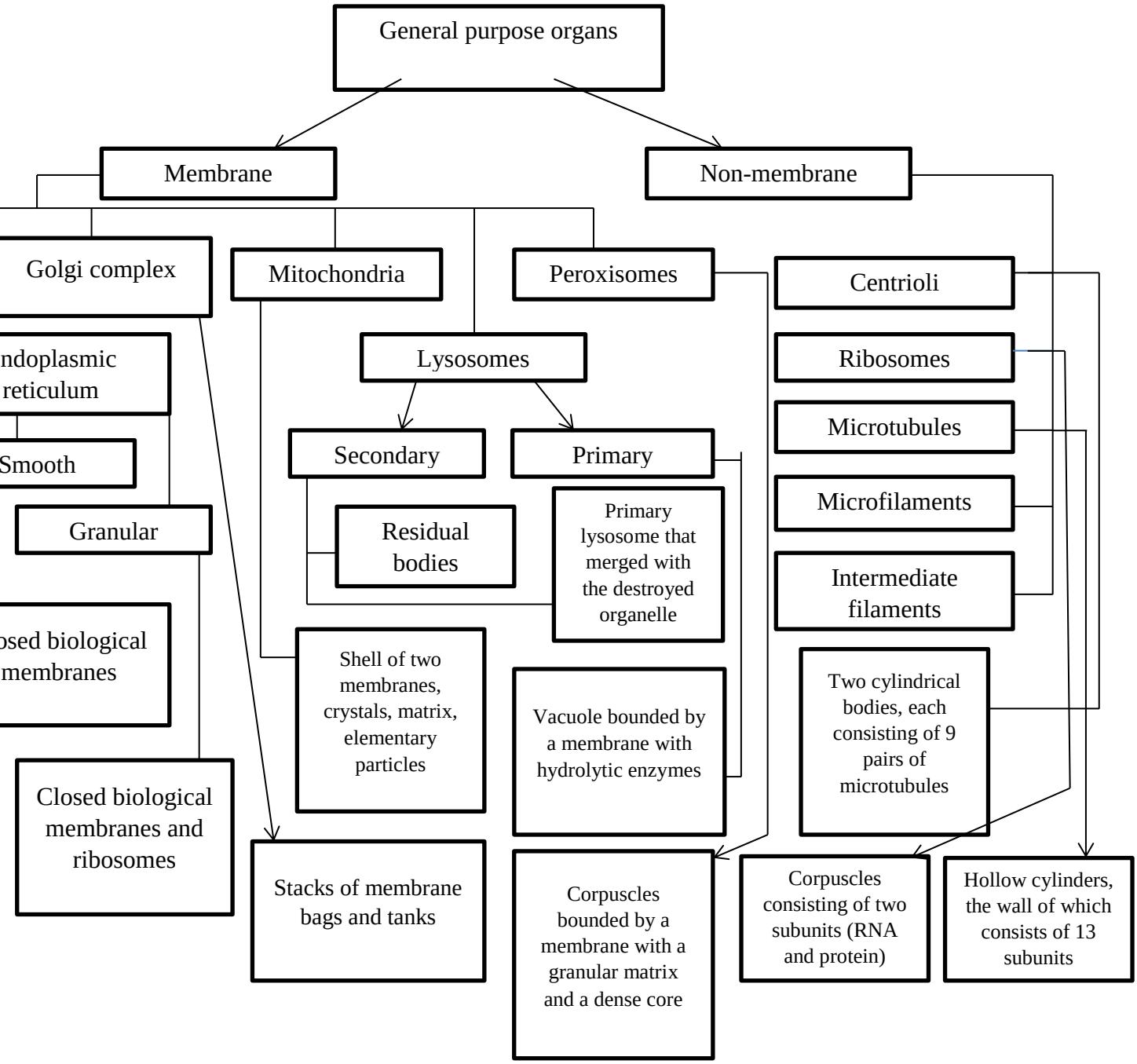
Centrosome is a microscopic non-membrane organelle of general purpose, described by W. Fleming in 1875, which ensures the separation of chromosomes during cell division. In a cell that is not preparing for division, the centrosome is located near the nucleus and consists of two fully formed centrioles surrounded by a centrosphere. Two adjacent centrioles are called a diplosome. Each centriole at its base contains nine triplets of parallel oriented microtubules, which in the spatial image form a cylinder. In addition to microtubules, the centriole includes specific macromolecular structures, the so-called

handles, with the help of which the triplets are interconnected. The "handles" contain the protein dynein, which has ATPase activity and plays a crucial role in the mechanisms of motor functions of centrioles. The long axes of both centrioles are located in mutually perpendicular planes. The centrosphere is an organelle-free hyaloplasm around the centrioles, which is radially penetrated by microfilaments and microtubules. During the preparation of the cell for division, the centrioles are doubled (duplicated), followed by the separation of each newly formed pair to the poles of the cell. The basis of centrosome functional activity is the mechanism of stimulation of tubulin polymerization, which causes the growth of existing and formation of new microtubules.

Cilia and **flagella are** thin outgrowths of cytoplasm, which are based on a highly organized system of microtubules. The length of cilia is 5-10 microns, flagella reaches 150 microns. Outside the cilia are covered with plasmolemma, inside it there is an axial axoneme thread. The axoneme contains nine pairs (doubles) of microtubules that form a hollow cylinder. The central pair of microtubules is located in the center of this cylinder. The axoneme microtubule system is described by the formula (9x2)+2. At the base of the cilia, in the area of its transition to the cytoplasm, there is a so-called basal body, which is similar in structure to the centriole and consists of nine microtubule triplets. The formula of the microtubule system of the basal body is (9x3)+0, that is, the same as in the centriole. Often at the base of the cilia there are two basal bodies, the long axes of which are placed at right angles to each other. The basal body and axoneme are interconnected: two microtubules from each triplet of the basal body continue into the doublets of microtubules of the axoneme. Slight displacements of microtubule doublet can cause bending of the whole cilia or flagellum. In different cells, the movement of cilia and flagella can resemble the movement of a pendulum, be funnel-shaped, undulating, etc. Free cells with cilia and flagella can move in space (e.g. spermatozoa), fixed cells with cilia on the apical surface can transport fluid, mucus or particles or cells suspended in them (e.g. ciliated cells of the respiratory tract, fallopian tubes, etc.)

Inclusions, unlike organelles, are not permanent structural components of the cytoplasm and do not have a clearly defined structure. Inclusions can be exo- and endogenous. The latter, depending on their functional purpose, are divided into excretory, trophic, pigmentary. Inclusions can be considered as macromolecular conglomerates that the cell accumulates in the cytoplasm. Thus, trophic inclusions (lipids and glycogen) are a source of substrates for energy formation or steroid synthesis. They are present in cells with a high metabolic rate (muscle cells, hepatocytes) and in endocrinocytes that form steroid hormones (glucocorticoids, androgens, progesterone). The presence of trophic inclusions is associated with the development of endoplasmic reticulum and mitochondria. In cells that produce steroids, in addition to smooth endoplasmic reticulum and lipid droplets, mitochondria with tubulo-vesicular cristae are also detected. An increase in the number of lipid and carbohydrate inclusions may be a sign of metabolic disorders. No less important for diagnosis are pigment inclusions. Hemoglobin in red blood cells and myoglobin in skeletal muscles contain iron, the main functions of which are binding, transport and storage of oxygen. Varieties of pigment inclusions are lutein (pigment of cells of the corpus luteum of the ovary) and lipofuscin (the most important sign of cell aging).

Graph logical structure of the lesson



Equipment: slides**,** histological micro-sections, microscope, electronograms.

The plan:

Technological map of the lesson for full-time training

	Stages	Hour	Means of training	Equipment	Venue.
1	Greetings. Checking the attendees	5		Progress log	Study room
2	Checking the baseline	15	Test questions, situational tasks		
3	Correction of assimilation of theoretical material	20		Tables, slides, micro preparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Drawing up a protocol of practical training.	20	Atlas with microdrugs and EG	Microscope, micro preparations, album	
6	Analysis of the results. Summing up the results	15	Checking the practical part of the lesson		

Technological map of the lesson for online learning

	Stages	Hour	Means of training	Equipment	Venue.
1	Greetings. Checking the attendees	3		Progress log	Study room
2	Checking the baseline	15	Test questions, situational tasks		
3	Correction of assimilation of theoretical material	10		Tables, slides, micro preparations	
4	Checking the initial level of training	15	Written assignments, surveys		
5	Independent work. Drawing up a protocol of practical training.	15	Atlas with microdrugs and EG	Microscope, micro preparations, album	
6	Analysis of the results. Summing up the results	2	Checking the practical part of the lesson		

Control of the reference level of knowledge:

Basic knowledge, skills, abilities

Discipline	**To know**	**Be able to**
Biology	The general organization of eukaryotic cells.	Recognize cells and non-cellular formations, distinguish the components of eukaryotic cells.

Control questions

1. General organization of the cell.
2. Modern concepts of biological membranes.
3. Cluster-mosaic model of biomembrane structure.
4. Membrane, supra- and submembrane components of the cytolemma, their structural, chemical and functional characteristics.
5. Transmembrane transport of substances.
6. Characteristics and types of exo- and endocytosis.
7. Receptor functions of the cytolemma.
8. Intercellular contacts, their types, structure and functions.
9. The main components of the cytoplasm.Classification of organelles.
10. Morphofunctional characteristics of membrane organelles (endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, mitochondria).
11. Morphofunctional characteristics of non-membrane organelles (ribosomes, centrioles, microtubules and microfilaments).
12. Inclusion. Definition, classification, meaning.

Test tasks:

1. A cell was treated with a substance that blocks the process of nucleotide phosphorylation in mitochondria. What process of cell life will be disrupted?
A. Synthesis of mitochondrial proteins
B. ATP synthesis
C. Oxidative phosphorylation
D. Integration of functional protein molecules
E. Fragmentation of large mitochondria into smaller ones

2. In the cytoplasm of pancreatic cells during the secretory cycle in the apical part of the granules of secretion appear and disappear. What structural elements of the cell it concerns
A. Inclusion
B. Microfilaments
C. Lysosomes
D. Phagocytic vacuoles
E. Ribosomes

3. Low levels of Albumin and Fibrinogen were found in the patient's blood. Decrease of activity of which hepatocyte organelle is most likely to cause this phenomenon?
A. Lysosomes
B. Peroxisomes
C. Golgi apparatus
D. Granular EPS
E. Aggregate EPS

4. In a patient poisoned with CCl4, there is a violation of the integrity of lysosome membranes in most liver cells. What will be the result of exposure of liver cells to the poisonous substance?

A. Does not affect
B. Autolysis develops
C. Phagocytosis is activated
D. Pinocytosis is activated
E. Exocytosis is activated

5. The ribosome structure is damaged in the cell. What processes will be affected first of all?
A. Protein synthesis
B. DNA synthesis
C. Synthesis of carbohydrates
D. Lipid synthesis
E. Synthesis of mineral substances

6. The preparation shows cells whose cytoplasm is stained basophilically. What substances present in the cell cause this phenomenon?
A. DNA
B. Melanin
C. RNA
D. Carbohydrates
E. Lipids

7. Using a micromanipulator, an organelle was removed from the cell, resulting in disruption of carbohydrate synthesis, lysosome formation, packaging, maturation and excretion of secretory products of the cell. Which organelle was removed?
A. Agranular EPS
B. Granular EPS
C. Golgi apparatus
D. Cellular center
E. Microtubules

8. Micromanipulator damaged the structure of one of the parts of the cell, which violated the ability of the cell to control the formation and destruction of the organelle of the cytoskeleton - microtubules, the ability to divide. Which structure was most likely damaged?
A. Centrosome
B. Glycocalyx
C. The lamellar complex
D. Microfibrils
E. Mitochondria

9. On the free surface of a cell, structures were found in which 9 pairs of peripheral microtubules and 2 central ones are visible under an electron microscope. What are these structures called?
A. Cuticle
B. Microfibrils
C. Pseudo-events
D. Eyelashes

E. Centrioli

10. In the process of cell vital activity, the number of cisternae and tubules of the agranular endoplasmic reticulum increases dramatically. Synthesis of what substances is activated in the cell?

A. Carbohydrates and lipids
B. Proteins and lipids
C. DNA
D. RNA, protein
E. Glycoproteins

Situational tasks:

1. Exocytosis is the removal of cellular waste products outside the cytoplasm. What does not belong to the types of exocytosis?

2. Allocation by the cell of the products of its synthetic activity necessary to ensure the physiological functions of the organs and systems of the body is:

3. The process of removal from the cell of compounds that do not change their chemical structure in the process of intracellular metabolism (water, mineral salts) is called?

4. The process of excretion of toxic metabolic products to be excreted outside the cell is called?

5. Connective tissue macrophages participate in cellular immunity by engulfing bacteria and other microorganisms. How does this happen?

6. Tissue cells are able to capture and transport inside micromolecular compounds that are in dissolved form. What is this transport of substances called?

7. The chemical components of cell membranes are proteins, lipids and carbohydrates. How many percent are lipids?

8. The chemical components of cell membranes are proteins, lipids and carbohydrates. How many percent are carbohydrates?

9. In tissue culture, nuclei in the nucleus are damaged by radiation. Restoration of which organelle in the cell cytoplasm will be problematic?

10. Using a micromanipulator, an organelle was removed from the cell, in which two membranes can be distinguished (outer smooth and inner with outgrowths). In addition, the organelle has its own genetic apparatus. Which organelle was removed?

11. A number of cells in the body can move like amoebae, forming temporary short outgrowths. What cellular structures provide this function?

12. Using a micromanipulator, an organelle was removed from the cell, without which the formation of microtubules and the spindle of division during mitosis is impossible. Which organelle was removed?

13. Agranular endoplasmic reticulum performs a number of important functions. What functions are not typical for it?

14. Using a micromanipulator, an organelle consisting of two subunits, each of which is represented by a ribonucleoprotein weight, was removed from the cell. Which organelle was removed?

15. A micromanipulator damaged an organelle in a cell, which contains proteolytic enzymes capable of breaking down biopolymers. Which organelle was removed?

15.In a cell some organelles are able to synthesize protein. In which of the following organelles does this process not occur?

16. In the cytoplasm of cells studied organelle, which is a system of closed membranes covered with ribosomes, which provides synthesis and transport of proteins. What kind of organelle is it?

17. In the cytoplasm were found rounded sacs formed by biomembranes with a diameter of 0.2-0.5 microns, filled with enzymes, among which catalase is a marker. Functionally provide utilization of reactive oxygen. Name them.

18. The system of membrane tubes, tubules, bubbles, functionally related to the metabolism of lipids and carbohydrates, detoxification of harmful chemical compounds for the cell, deposition of calcium ions was studied in cells. Name the organelle.

19. In the cytoplasm of cells, hollow fibrous structures with a diameter of about 25 nm, built of globular protein subunits, were studied. What are these structures and what protein is in their composition?

20. Based on the analysis of the ultrastructural picture of the cell, the researcher concluded that the granular EPS and Golgi complex are most developed in the cell. What does this cell probably specialize in?

Tasks for the formation of practical skills and abilities:

Preparation 1: Inclusion of fat (Fig. 1).

High magnification. Study and sketch the preparation. The slide shows polygonal cells with large red nuclei. In the pink granular cytoplasm there are black rounded inclusions of different sizes (fat inclusions).

In the figure mark: 1) liver cells: a) lipid inclusions; b) nucleus; 2) capillary with red blood cells.

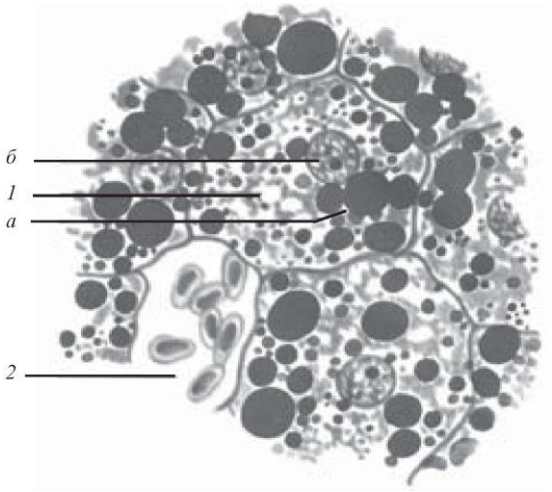


Figure 1. Inclusion of fat in axolotl liver cells. Staining with osmic acid. Safranin × 900:

1 - liver cells (*a* - lipid inclusions; *b* - nucleus); *2* - capillary with red blood cells

Preparation 2: Inclusion of glycogen (Fig. 2).

Low magnification. Examine the specimen. At this magnification, find the central part of the section, where the glycogen in the cells is quite evenly distributed.

High magnification. In the center of the section, there are red glycogen fascicles located throughout the cytoplasm of the cells and purple nuclei. On the periphery of the section, the glycogen depths may merge on one half of the cell, while the other half remains transparent. Sketch the preparation.

In the figure mark: 1) liver cells; 2) cytoplasm with glycogen inclusions; 3) nucleus; 4) blood capillary.

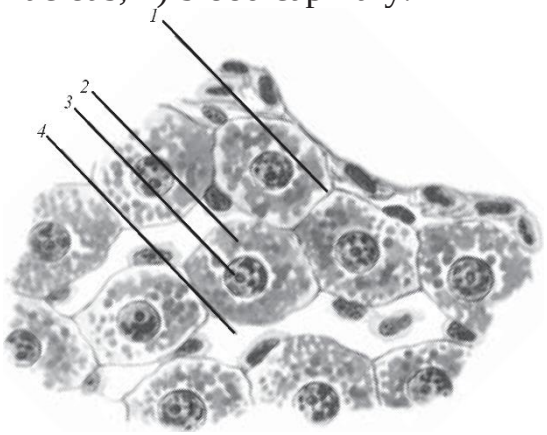


Figure 2. Glycogen incorporation in Axolotl liver cells. Staining with carmine Besta-hematoxylin × 900:

1 - liver cells; *2* - cytoplasm with glycogen inclusions; *3* - nucleus; *4* - blood capillary

Preparation 3. Golgi complex (Fig. 3).

Low magnification. Examine the specimen. Find large cells, around the nucleus of which a grid of Golgi apparatus is visible. The cytoplasm has a greenish color.

High magnification. Consider the nucleus (it is light, large, with a brown nucleus). Around the nucleus, the Golgi complex is clearly distinguished, colored in black. Sketch the preparation.

High magnification. Consider the nucleus (it is light, large, with a brown nucleus). Around the nucleus, the Golgi complex is clearly distinguished, colored in black. Sketch the preparation.

In the figure mark: 1) nucleus; 2) Golgi complex; 3) cytoplasm.

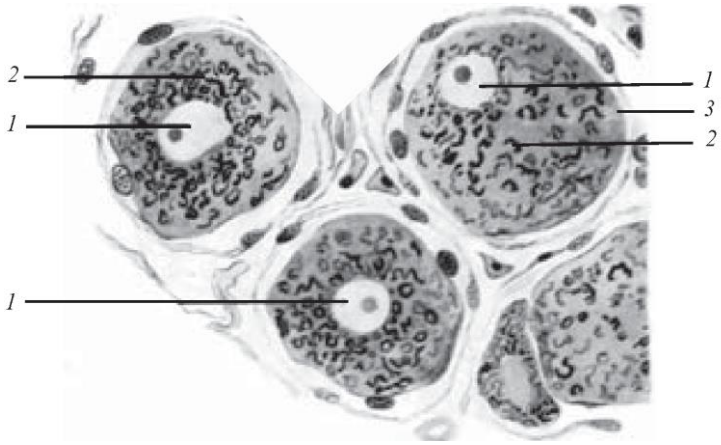


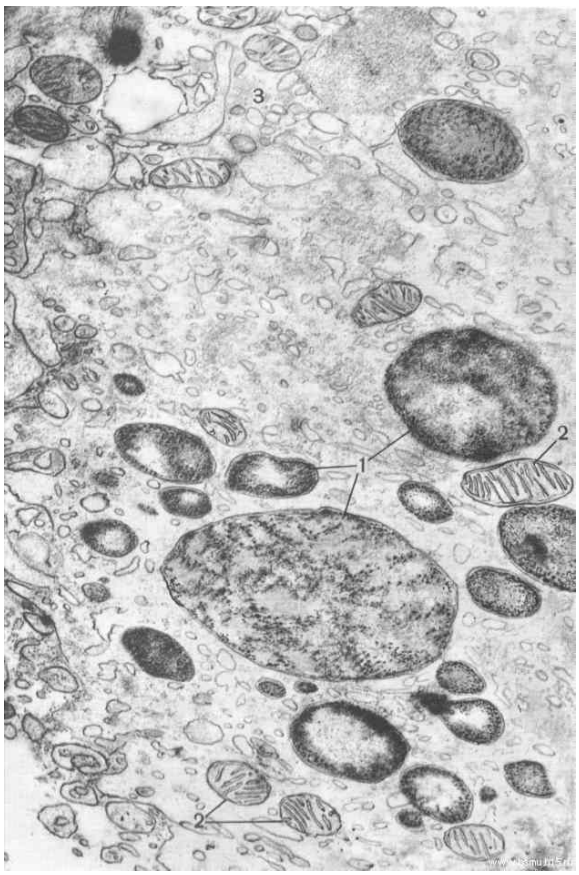
Fig. 3. Golgi complex. Osmium impregnation ×400: *1* - nucleus; *2* - *Golgi* complex; *3* - plasmolemma

Electron microphotographs.

1. Lysosomes.
2. Plate complex
3. Granular endoplasmic reticulum.
4. Mitochondria with lamellar cristae.
5. Mitochondria with vesicular cristae.

Lysosomes

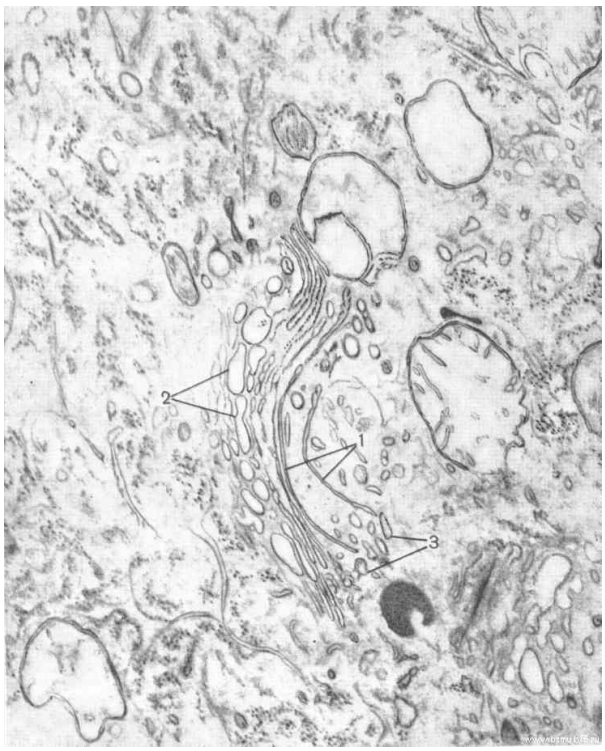
Electron micrograph of a part of macrophage cytoplasm from a rat lymph node. × 26 000



1 - lysosomes (secondary) with electron-dense particles; 2 - mitochondria; 3 - endoplasmic reticulum.

Plate complex

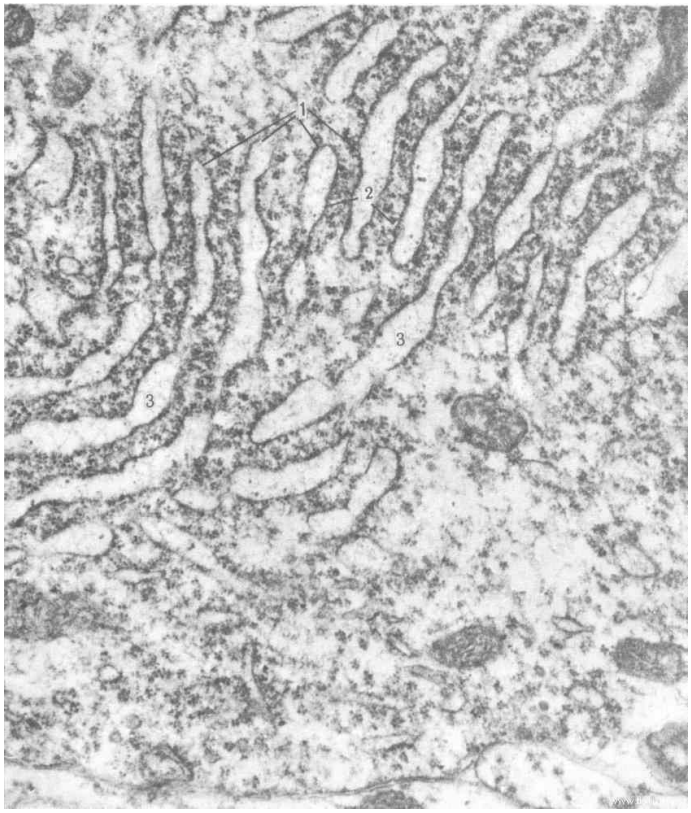
Intracellular reticular apparatus (Golgi apparatus). Electron micrograph of a part of nerve cell cytoplasm from a rat spinal node. × 84 000



1 - cisternae of Golgi complex (GC) [γ - cytomembranes]; 2 - vacuoles (or blisters); 3 - vesicles (or vesicles).

Granular cytoplasmic network (tigroid substance)

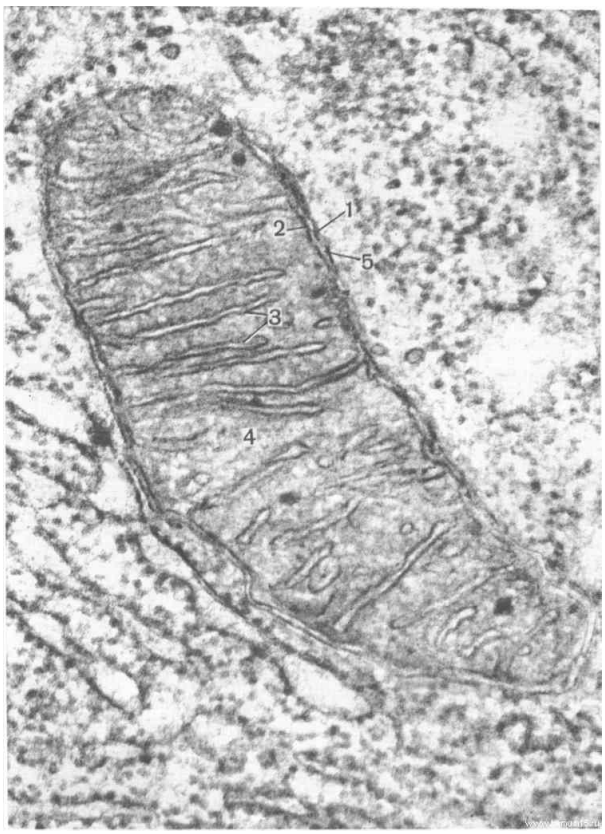
Tigeroid substance. Electron micrograph of a part of a nerve cell. × 30 000



1 - EPS membranes; 2 - ribosomes (fixed on gEPS); 3 - cisternae.

Mitochondria with lamellar cristae

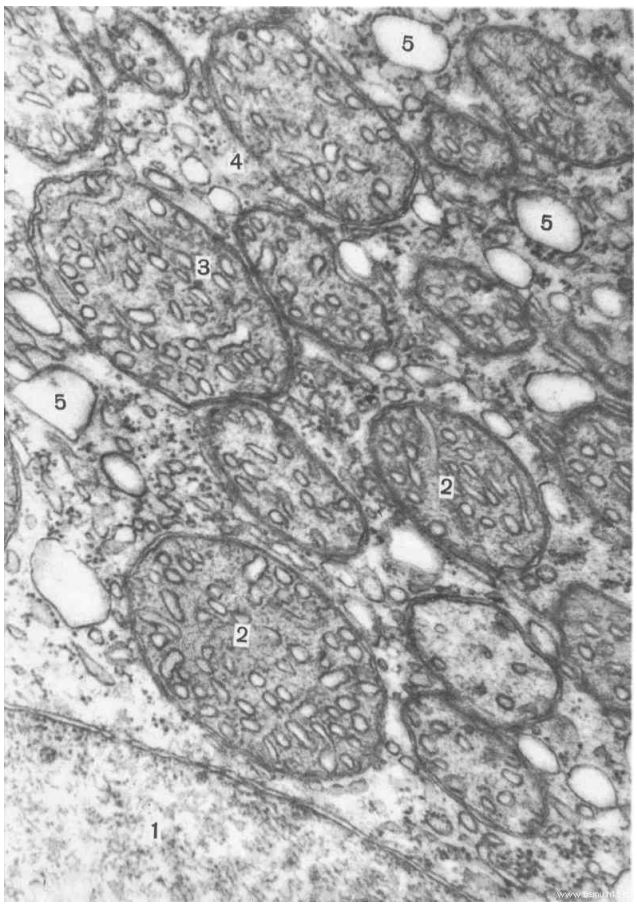
Mitochondria. Electron micrograph of a cell of the terminal part of the pancreas. × 100 000



1 - outer mitochondrial membrane; 2 - inner mitochondrial membrane; 3 - mitochondrial combs (cristae); 4 - mitochondrial matrix; 5 - intermembrane space [outer mitochondrial chamber]. 6 - mitochondrial inclusions

Mitochondria with vesicular cristae (reticular zone of the adrenal gland)

The reticular zone of the adrenal cortex of the rat. Electron micrograph. × 65 000



1 - nucleus; 2 - mitochondria; 3 - vacuoles and cristae in mitochondria; 4 - vacuoles of endoplasmic reticulum; 5 - cisternae of endoplasmic reticulum; 7 - ribosomes

Control materials for the final stage:
Test tasks

1. Chemical factor acted on the plasma membrane. As a result, the cell changed its shape. Which layer of the cell membrane plays a decisive role in this process?

A. Cortical
B. Glycocalyx
C. Bilipid
D. Hydrophilic
E. Hydrophobic

2. Harmful environmental factors have led to a sharp drop in the intensity of endocytosis and exocytosis in liver cells. Which cell membrane layer was affected first of all?

A. Cortical
B. Lipoprotein
C. Supramembranous
D. Integral
E. Glycocalyx

3. The action of microbial toxins on cells caused significant damage to the glycocalyx. Which membrane function of the cells will be markedly disturbed?

A. Contact forming
B. Transport
C. Protective
D. Receptor
E. All of the above

4. Outside the cell are ions, the concentration of which in the cytoplasm is greater than extracellular. What are these ions? Is it possible for these ions to enter the cell? If so, what is the mechanism?

A. Na+, possibly by active transport
B. K+, possibly by active transport
C. Ca2+, possibly by passive transport
D. K+, possibly by diffusion
E. H+, impossible

5. The cell was treated with substances that disrupt the conformation of proteins that make up the cytolemma. What functions of the cell surface will be disturbed?

A. Transport and receptor
B. Protective
C. Plastic
D. Respiratory
E. Trophic

6. The distance between the plasmoles of adjacent cells is 15-20 nm on the preparation. At the same time, the glycocalyx layers of neighboring cells interact. What type of contact is this?

A Synapse
B. Nexus
C. Desmosome
D. Slotted
E. Simple

7. The preparation shows the structure represented by disc-shaped thickenings of both contacting areas of plasma membranes of neighboring cells. The width of the intercellular gap is about 25-30 nm, filled with electron-dense substance, in which special fibrous structures are distinguished. What type of contact is it?
A Synapse
B. Nexus
C. Desmosome
D. Slotted contact
E. Simple contact

8. The general principle of structure of all membranes that make up different cell organelles is the same. What explains the specific functions of each organelle?
A. Qualitative composition, topography and conformation of proteins
B. Size of the organelle
C. Chemical composition of the internal contents
D. The ability to phagocytosis
E. Qualitative composition of lipids

9. The chemical components of cell membranes are proteins, lipids and carbohydrates. How many percent are proteins?
A 5 - 10%
B. 60%
C. 40%
D. 0 -20%
E. 80 -90%

10. Cell membranes perform a number of functions. Which of the functions is not typical for them?
A. Separation
B. Reception
C. Transport
D. Breathing
E. Ensuring intercellular contacts

11. The EM-photograph of the myocardium shows the contact zone of two adjacent cells with a length of 0.5 microns, where the plasma membranes are separated by a gap 2-4 nm wide. In the contact zone, an ion channel formed by protein complexes is determined. What type of contact is it?
A. Nexus

B. Desmosome
C. Synapse
D. Tight closing contact
E. Simple contact

12. Plasma membrane is a barrier-receptor and transport system of the cell, which has a liquid-mosaic structure. What structures are included in its composition?
A. Bilipid layer
B. Cortical layer
C. Integral, semi-integral proteins
D. Glycolipids, glycoproteins
E. All of the above

13. This type of connection is characteristic of nervous tissue and occurs in specialized areas of contact between two neurons. Name this type of contact.
A. Simple contact
B. Nexus
C. Synapse
D. Slotted contact
E. Adhesive strip

14. The cell membrane contains a significant number of proteins with different functional purposes. Which function is not characteristic of membrane proteins?
A. Enzymatic
У. Receptor
C. Transport
D. Structural
E. Protective

15.In an experiment, a cell was observed to release its own structural components. What is this phenomenon called?
A. Secretion
B. Recreation.
C. Excretion
D. Clasmatosis
E. Endocytosis

16. Name which protein-cytoskeleton structure relationship is characteristic of chemomechanical interaction in eyelashes? A. Dynein, microtubules
B. Myosin, microtubules
C. Actin, microfilaments
D. Tubulin, intermediate filaments
E. Kinesin, intermediate filaments

17. Prolonged exposure to toxic substances has led to a significant reduction in

protein synthesis in hepatocytes. Which organelle is most affected by intoxication?
A. Granular endoplasmic reticulum
B. Mitochondria
C. Microtubules
D. Lysosomes
E. Golgi complex

18. To start the mechanism of muscle contraction, a sufficient amount of calcium ions is required. In which organelle is it accumulated?
A. Granular endoplasmic reticulum
B. Mitochondria
C. Lysosomes
D. Agranular endoplasmic reticulum
E. Golgi complex

Situational tasks:

1. Diffuse basophilia of the cytoplasm is often observed in fast-growing cancer cells, normal cells of developing embryos, the cell proliferates rapidly in the process of repairing damaged tissues. With the presence of a large number of which organelle can be associated this phenomenon?

2. Violation of the normal metabolic function of lysosomes is the cause of a number of diseases - the so-called accumulation diseases. With the formation and accumulation of what structures is it associated?

3. Based on the analysis of the ultrastructural picture of the cell, the researcher concluded that it actively synthesizes and excretes substances belonging to the cholesterol group. Strong development of which organelle is most characteristic of this cell?

4. In the treatment of malignant tumors, the alkaloid vinblastine is used, the therapeutic effect of which is based on the ability to cause aggregation of tubulin protein into crystal-like structures and thereby prevent its polymerization into microtubules. What process in the development of tumors is stopped?

5. Liver cells are involved in detoxification of some drugs, such as barbiturates. On the number of which organelle in cells depends the resistance of an individual to its pathological effects?

6. In an electron microscope, it looks like a homogeneous or fine-grained substance; from a physicochemical point of view, vision is a complex colloidal system capable

of changing from an ash-like state to a gel-like state and back. Name the structure of a cell.

7. Cytochemical study revealed a high content of hydrolytic enzymes in the cytoplasm. What organelle activity is associated with this fact?

8. In the human diet a large amount of carbohydrates. What structures will be found in the cytoplasm of hepatocytes?

9. During a scientific experiment, a researcher destroyed the structure of one of the parts of a cell, which disrupted the cell's ability to divide. Which structure was most likely damaged?

10. A 7-year-old child with a congenital disease has abnormal biopolymers in the cells of the body. What organelle dysfunction is in question?

11. Low levels of Albumin and Fibrinogen were found in the patient's blood. Decrease of activity of which organelle of hepatocytes is most likely to explain this phenomenon?

Summing up the results:

The structure of the current assessment in the practical class:

1. Evaluation of theoretical knowledge on the topic of the lesson:
   methods: surveys, solving situational problems and test tasks;
   maximum grade - 5, minimum grade - 3, unsatisfactory grade - 2.
2. Assessment of practical skills and keeping a practical notebook on the topic of the lesson:
   Methods: assessment of the correctness of filling in the practical workbook (tables and figures)
   maximum grade - 5, minimum grade - 3, unsatisfactory grade - 2;

Criteria for the current assessment in the practical class:

"5"	The student is fluent in the material, takes an active part in discussing and solving situational and test problems, confidently demonstrates practical skills in working with micro preparations, expresses his opinion on the topic of the lesson, demonstrates basic knowledge.
"4"	The student has a good command of the material, participates in the discussion and solution of situational and test problems, demonstrates practical skills in working with micro preparations with some mistakes,

	expresses his opinion on the topic of the lesson, demonstrates basic knowledge.
"3"	The student has insufficient knowledge of the material, hesitantly participates in the discussion and solution of situational and test problems, demonstrates practical skills when working with micro preparations and electronograms.
"2"	The student does not know the material, does not participate in the discussion and solution of situational and test problems, does not demonstrate practical skills when working with micro preparations and electronograms.

List of recommended literature .

The main one:

1. Lutsyk O.D., Tchaikovsky Y.B. Histology, cytology, embryology Vinnytsia, New Book, 2018.
2. Barinov E.F., Tchaikovsky Y.B. General histology and embryology of internal organs: textbook.Kyiv: Medicine; 2013
3. Wojciech Pawlina. Histology: textbook and atlas. WSV: Medicine, 2021.

Additional:

4. Histology and embryology of internal organs: textbook / E.F. Barinov, Y.B. Tchaikovsky, O.M. Sulaeva et al.
5. Cytology of human organs and tissues edited by L.S.Bolgova. Kyiv: Book-plus, 2018, p.288

METHODOLOGICAL DEVELOPMENT
practical training
in the discipline of histology, cytology and embryology

Faculty, medical course I course
Academic discipline histology, cytology and embryology

Approved:
By the meeting of the Department of Histology, Cytology and Embryology
of Odesa National Medical University

Minutes № ___ of "___" _____ 20__ p.

Head of the Department _____ (___Tiron O.I._____)

Developers:
Ph. _ Associate Professor, Tiron O.I. _
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Candidate of medical sciences, senior lecturer. Markova O.O.
senior lecturer Lyashevska O.O.

Practical lesson №3

Topic: Cytology. Cytoplasm. Cytoskeleton. The system of cytoprotection and self-renewal of the cell. Nucleus. Cell reproduction. Cell cycle. Mitosis. The life cycle of the cell. Differentiation. Aging. Cell death.

Purpose: The nucleus of the cell is a system of genetic determination and regulation of the processes of protein synthesis of the cell. It stores, implements and reproduces genetic information. Violation of the morphological and chemical composition of the nucleus is associated with the development of abnormalities in the number and structure of chromosomes, gene defects, cell death, which causes the development of congenital and hereditary diseases.

Some cells of a mature organism are low differentiated, they are capable of proliferation (division). These cells are in the cell cycle, dysregulation of which causes the development of pathological processes such as tumor transformation, hypo- and atrophy of organs.

Targeted assessment of various morphogenetic processes (proliferation, differentiation, functional activity, aging and cell death) is based on a comprehensive analysis of the structural elements of the cell.

Basic concepts:

Nucleus is an important component of the cell. Together with the cytoplasm, the nucleus forms a single integrated system that is in a state of dynamic equilibrium. The cell cannot exist for a long time without the nucleus (it quickly dies in case of its removal - enucleation), but the nucleus without cytoplasm is not capable of independent life. The term "nucleus" belongs to R. Brown, who first used it in 1833, describing plant cells.

The nucleus performs two groups of general functions. The first is related to the preservation of genetic (hereditary) information among cell generations. These are the following functions: maintaining the constant structure of DNA with the help of so-called repair enzymes that can restore the DNA molecule after its damage (including radiation); replication of DNA molecules (qualitative and quantitative doubling of genetic material); distribution of genetic material between daughter cells during mitosis; recombination of genetic material during meiosis. The second group of nuclear functions concerns the implementation of genetic information, that is, the creation of the apparatus of protein synthesis. These functions include the synthesis of all types of RNA (informational, transport, ribosomal), as well as the construction of ribosomes.

Shape, size, number of nuclei and nuclear-cytoplasmic ratio in different cell types

All cells in the human body contain a nucleus, with the exception of highly specialized blood cells - red blood cells, which lose their nucleus in the process of their development and are nuclear-free. The vast majority of cells contain one nucleus, but there are binuclear cells (20% of liver cells), as well as multinuclear cells (for example, osteoclasts - bone cells).

The nuclei are most often spherical in shape, but can have another shape - rod-shaped, bean-shaped, annular, segmented. The shape of the nucleus depends on the shape of the cell (elongated smooth muscle cells have an elongated rod-shaped nucleus); on the number of inclusions (the nucleus of a fat cell becomes flattened under the influence of a large fat droplet that occupies almost the entire cell); the location of the organelles (the shape of the monocyte nucleus is bean-shaped due to the location of the centrosome in the place of its deepening). The nucleus is always localized in a certain place of the cell. For example, in cylindrical cells of the stomach and intestine, it occupies a basal position. Each cell type has a constant ratio between the volume of nucleus and cytoplasm. This constant is called the Hertwig index. According to the values of this index, cells are divided into nuclear (with a large Hertwig index) and cytoplasmic (with a small Hertwig index).

General structural characteristics of the nucleus

The nucleus can be in two states - mitotic (during division) and interphase (between divisions). The interphase nucleus is also called metabolic, which emphasizes its functional state. In a living cell, the interphase nucleus looks optically empty, only the nucleus is visible. The structures of the nucleus in the form of filaments, grains in a living cell can be observed only during the action of damaging agents on it, when the cell enters a state of so-called paranecrosis (a state on the verge of life and death). From this state, the cell can either return to normal life or die. Morphologically, the following changes of the nucleus are distinguished in case of cell death: karyopyknosis (compaction), karyorexis (decay), karyolysis (dissolution).

On a fixed and stained preparation in the composition of the interphase nucleus

distinguish poison

Connection of nucleus and cytoplasm. Nuclear pores

The nuclear envelope is not continuous, its characteristic structures are specific openings called nuclear pores. The pores are formed by the fusion of two nuclear membranes and are rounded through perforations with a diameter of 80-90 nm. They are filled with complexly organized globular and fibrillar structures, which together with the membrane perforation form the so-called pore complex. The latter is built of three rows of granules, eight in each row. The granules are located on the border of the hole in the nuclear envelope: one row lies on the side of the nucleus, the second - on the side of the cytoplasm, the third - in the central part of the pore. The central granule is located in the center of the pore. Fibrillar protein structures extend from the granules, which converge in the center, forming the so-called pore diaphragm. The size of nuclear pores for each cell type is constant. The number of pores per unit surface area of the nucleus can vary depending on the functional state of the cell, its metabolic activity: the higher it is, the greater the density of pores on the surface of the nucleolus.

Functions of the nuclear envelope

Nuclear envelope performs a number of important functions. The first of them is a barrier function: the nuclear envelope separates the contents of the nucleus, its genetic material from the cytoplasm, restricts free access to the nucleus and the exit of various substances from it. The second function is to regulate the transport of macromolecules between the nucleus and the cytoplasm. For example, it is known that histones and other non-histone proteins after synthesis in the cytoplasm migrate to the nucleus. The reverse process of transport of substances from the nucleus to the cytoplasm is also known. This primarily concerns the transport of RNA and ribonucleoproteins, which are formed exclusively in the nucleus. Transport of high molecular weight compounds and ribosomes through the nuclear envelope is carried out through the pores. One of the essential functions of the nuclear envelope is to participate in maintaining the internal structure of the nucleus in interphase by fixing the chromosomal material to the inner nuclear membrane. There is evidence of a predominant connection of heterochromatin regions of interphase chromosomes with the nuclear envelope. It is known from classical cytological descriptions that a part of chromatin is localized at the periphery of the nucleus. This so-called peripheral chromatin is structurally connected with the inner nuclear membrane. In addition to peripheral chromatin, centromeric, telomeric and nuclear regions of heterochromatin, sex chromosomes, etc. are in contact with the nuclear envelope. Thus, it can be assumed that each chromosome decondensed in the interphase is "anchored" on the nuclear envelope by heterochromatin sites and thus its position becomes fixed in the nucleus space.

Chromatin. Structure and chemical composition.

Chromatin. On a fixed and stained preparation in the interphase nucleus, grains, lumps that are well stained with basic dyes are visible. This component of the nucleus was first described by Walter Fleming in 1881 and called chromatin (from the Greek "chroma" - color, dye). Chromatin is the basic structure of the interphase nucleus, which determines the specific chromatin pattern of the nucleus for each cell type. This pattern is like the cell's own seal, which allows to recognize different types of cells. Chromatin is a structural analogue of chromosomes, which can be seen only during mitosis. The chemical composition of chromatin is the same as that of chromosomes: the backbone is a DNA molecule surrounding histone proteins. In addition, chromatin contains a small amount of RNA - products of the transcription process. At the ultrastructural level, the interphase heterochromatin contains filaments, which are built of threads. The basis of the latter is a DNA molecule complexed with histones, which looks like a necklace. Each bead, called a nucleosome, consists of a fragment of a double helix of DNA wrapped around a protein core (cortex) built of eight histone molecules. Nucleosomes cause supercompaction of DNA molecules in these areas. In addition, electron microscopy reveals structures in the nucleus that are considered to be products of chromatin transcriptional activity. These include perichromatin fibrils, perichromatin granules and interchromatin granules. In some cases, the whole chromosome during the interphase may remain in a condensed (i.e. heterochromatinized) state, in the form of a lump of heterochromatin. For example, one of the X chromosomes in the somatic cells of the female body is subject to heterochromatinization in the initial stages of embryogenesis (during division) and does not function.

Euchromatin and heterochromatin

There are two types of chromatin: heterochromatin and euchromatin. The first corresponds to chromosome regions condensed during interphase; it is functionally inactive. This chromatin is well stained, it can be seen on the histological preparation. Heterochromatin is divided into structural (these are chromosome sections that are permanently condensed) and facultative (can be decondensed and transformed into euchromatin). Euchromatin corresponds to the chromosomes decondensed in interphase. It is a working, functionally active chromatin. It does not stain, it is not visible on the histological preparation. During mitosis, all euchromatin condenses and is incorporated into the x

Graph logical structure of the lesson

Cytology 2

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Test questions.

1. Cell nucleus. Core structural components and functions.
2. Morphology of chromosomes.

3. Chromatin. Types of chromatin, chemical composition.

4. Nuclear shell. Ultrastructural components and functions of karyoplasm.

5. Components of the nuclear pore complex.

6. The structure and functional significance of the nucleolus.

7. Cell cycle. Morphological and functional characteristics of interphase periods.

8. Mitosis. Mitotic phases and their characteristics. Biological significance.

Questions for individual work.

1. Endoreproduction, characteristics, meaning.

2. Adaptation of cells and its importance for the preservation of cells in changed conditions of existence.

3. Apoptosis, its biological and medical significance.

4. Aging and death of cells.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. It is known that interphase chromatin contains structures consisting of a DNA fragment twisted around a protein core built of eight molecules of histone proteins. What are these entities called?

2. The cell is in a period characterized by increased growth, mainly due to the accumulation of cellular proteins, enzymes necessary for the formation of DNA precursors, RNA metabolism are synthesized. What period is the cell in?

3. The cell is in a period characterized by a doubling of the amount of DNA. The level of RNA synthesis increases, respectively, with an increase in the amount of DNA, there is a doubling of the centrioles of the cell center. What period is the cell in?

4. The cell is in a period characterized by the synthesis of mRNA, rRNA, mitotic spindle proteins tubulins, necessary for the passage of mitosis, the accumulation of ATP for the energy supply of mitosis. What period is the cell in?

5. The cell is in a period characterized by high differentiation - the acquisition of biochemical and morphological features by the cell in connection with specialization. What period is the cell in?

6. When damaging agents act on the cell, nuclear disintegration is observed. What is this phenomenon called?

7. In the composition of the nuclear envelope there are holes filled with complexly organized globular (three rows of eight granules and one central) and fibrillar protein structures. What are their names?

8. In the process of monitoring the vital activity of the cell, an increase in the number of nuclear pores per unit surface of the nucleus was established. How can this phenomenon be explained?

9. On a fixed and stained specimen, the nucleus of the nerve cell looks optically transparent, with a well-distinguishable nucleolus. What is the form of the genetic material?

10. Under the influence of damaging agents, the fixation of the chromosomal material to the inner nuclear membrane is disturbed. Which of the functions of the nuclear envelope will be affected?

11. In a human blood smear, the segmented nucleus of a neutrophilic granulocyte is intensely violet, the nucleolus is not detected. What is the form of the genetic material?

12. As a result of exposure to glucocorticoids in the nuclei of some leukocytes, the activation of genes responsible for cell self-destruction occurred. What is this phenomenon called?

13. As a result of the action of a toxic substance during cell division, the alignment of chromosomes in the equatorial plane of the cell and the subsequent movement of chromosomes to the poles were disrupted. Which structure was affected?

14. The nucleolus is a non-independent, optional and non-constant structure of the nucleus, which is a derivative of:

15. A woman turned to medical genetic counseling on the issue of excluding hereditary pathology. At what phase of mitotic division is it most appropriate to study the human karyotype?

16. The normal course of mitosis was disrupted by the action on the cell of a drug that destroys the spindle of division. How many nuclei and with what set of chromosomes are formed as a result of such division?

17. The normal course of mitosis was disrupted, resulting in the formation of one mononuclear polyploid (tetraploid) cell. What are the possible reasons?

18. As a result of the expression of individual components of the genome, cells acquire their characteristic morphological, biochemical and functional features. Name this process?

19. In the process of acquisition by cells of morphological, biochemical and functional characteristics specific to them, cells are limited in the choice of possible paths of development. What is the name of this limitation of development paths?

Microslides.

1. Heterochromatin in blood smear leukocytes. Romanovsky-Giemsa staining.

2. Euchromatin in the nuclei of cells of the spinal ganglion. Hematoxylin - eosin staining.

3. Karyokinesis in onion root cells. Mitosis. Iron hematoxylin staining.

Histological specimen for study:
Specimen for examination 1. Heterochromatin of the nucleus of a neutrophilic segmented leukocyte of human blood (Fig. 1).

Small magnification. At this increase, find a segmented neutrophilic leukocyte on a human blood smear preparation.
High magnification. Examine the intense violet nucleus and pale cytoplasm.

Designate: 1) the nucleus of segmented neutrophilic leukocyte; 2) heterochromatin.

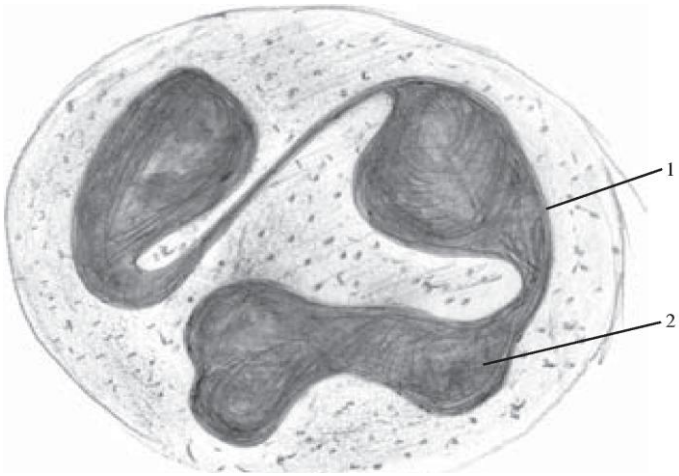


Figure: 1. Heterochromatin of the nucleus of neutrophilic segmented leukocyte of human blood. Romanovsky-Giemsa staining. × 900:
1 - nuclei; 2 - heterochromatin.

Specimen for examination 2. Euchromatin in the cell nuclei of the spinal ganglion (Fig. 2).
Small magnification. At this magnification, find the very cell with the largest nucleus.
High magnification. It is clearly seen that the cytoplasm is heterogeneous. The nucleus is located in the center, spherical in shape. It shows the nuclear envelope as a boundary line. The nucleolus is round, intense purple.
Throughout the karyoplasm, structured euchromatin is located in the form of deep.
In the figure, designate: 1) the cytoplasm; 2) nuclear envelope; 3) the nucleolus; 4) euchromatin; 5) mantle cells.

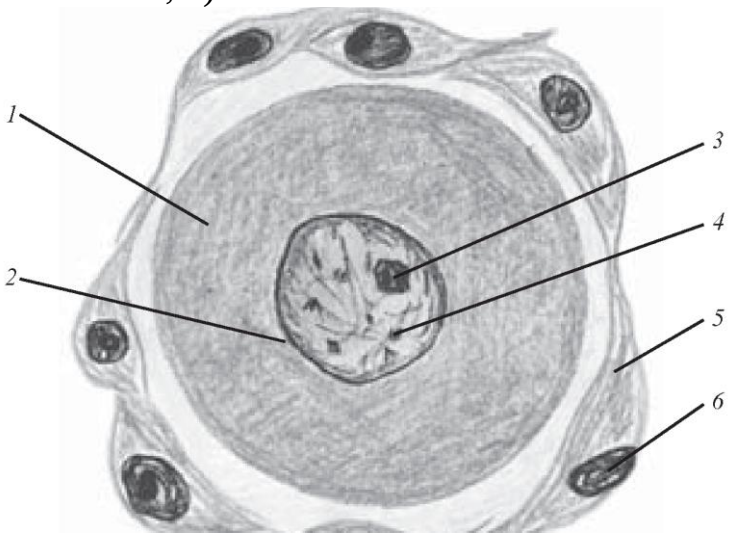


Figure: 2. Euchromatin of the nuclei of cells of the spinal ganglion. Hematoxylin-eosin staining. × 900:
1 - cytoplasm; 2 - nuclear envelope; 3 - nucleolus; 4 - euchromatin; 5 - mantle cells; 6 - nuclei of mantle cells

Specimen for examination 3. Karyokinesis in onion root cells (Fig. 3).
High magnification. At this magnification, find a cell in a stage of interphase, in the nucleus of which the membrane, nucleolus and chromatin granules are determined. In the prophase, chromosomes are visible, which form a dense or loose ball (in the late prophase). In metaphase, chromosomes are located in the plane of the cell's equator. In anaphase, chromatids are separated from each other and differentiated towards the poles, as a result of which two groups of chromosomes are visible in the cell, which have the appearance of a star. The telophase continues until the complete reconstruction of the nucleus, but it is more convenient to observe the early telophase, when each daughter star begins to merge into a more compact figure, but still retains the shape of a star, and in the cytoplasm, by slightly lowering the condenser, one can see a partition that is forming.
Designate: 1) interphase; 2) prophase; 3) metaphase; 4) anaphase; 5) telophase.

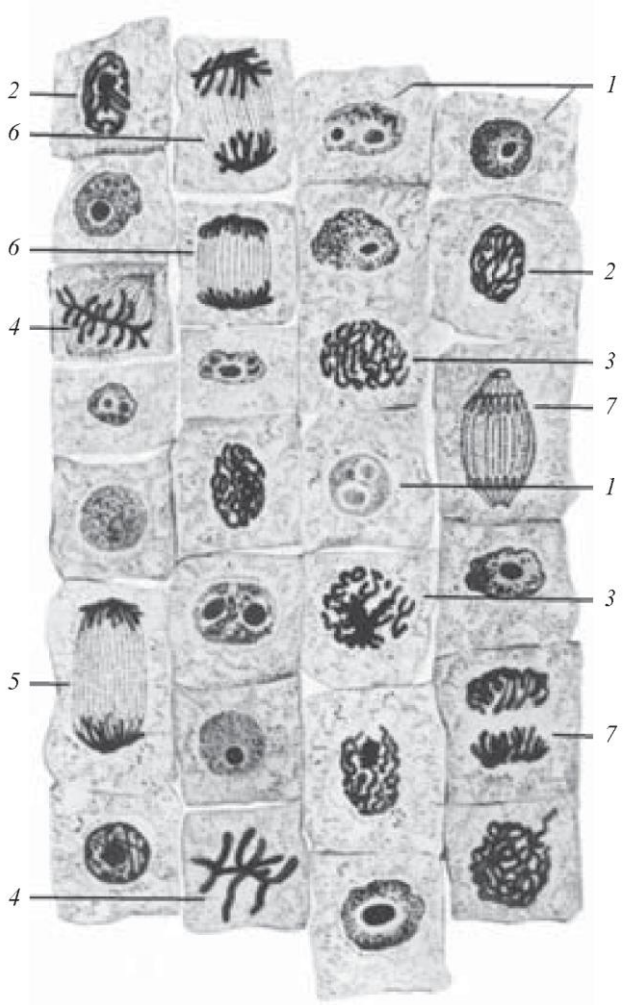


Figure: 3. Karyokinesis in onion root cells. Iron hematoxylin staining. × 400:

1 - interphase; 2 - prophase; 3 - prophase, loose lump; 4 - metaphase; 5 - achromatin spindle; 6 - anaphase; 7 - telophase

Electronic micrographs.

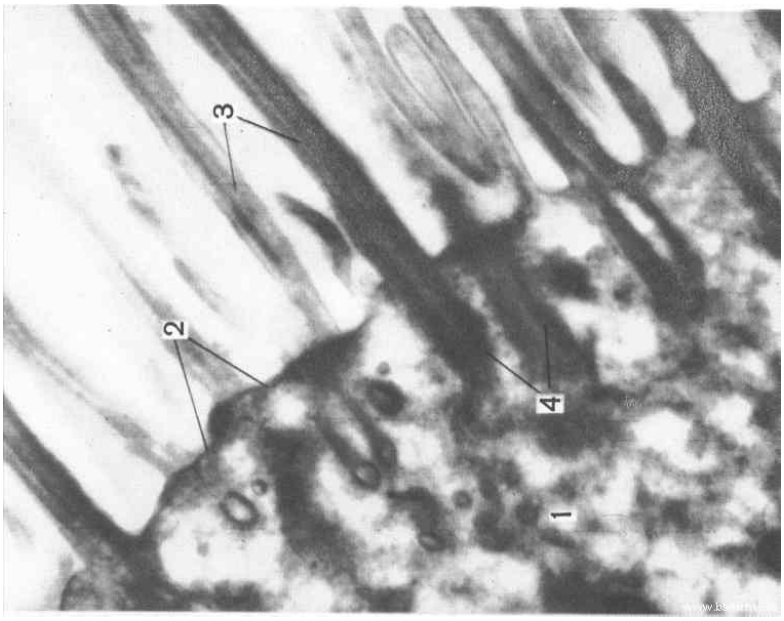
1. Cilia of the epithelial cell of the oviduct.

2. Karyolem.

3. Microvilli.

The cilia of the epithelial cells of oviduct

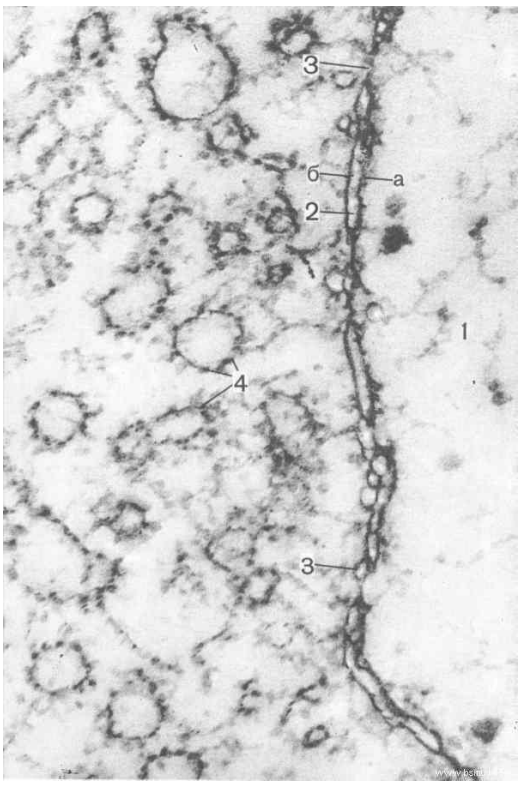
Apical portion of the ciliated epithelial cell of the mucosa of oviduct. Electronic microphotograph. × 63 000.



1 - cytoplasm; 2 - cytolemma; 3 - cilia; 4 – basal bodies (kinetosome).

Nuclear membrane

Nuclear membrane (kariolemma). Electronogram of the part of the giant cell of the salivary glands of chironomid. × 125 000



1 - nucleus; 2 – nuclear membrane (kariolemma): a – inner nuclear membrane; б - outer nuclear membrane; 3 – nuclear pores; 4 – rough endoplasmic reticulum [α-cytomembranes of endoplasmic reticulum] with rybosomes; 5 – perinuclear space (or cistern of nuclear membrane).

Microvilli (brush border)

Apical portion of the cells of the proximal segment of nephron. Electronogram. ×

124 000

1 – cellular microvilli forming the brush border; 2 – pinocytic vesicles.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. Synthesis of histone proteins is artificially blocked in the cell. Which cell structure will be affected first?

A. Nuclear shell

B. Nucleolus

C. Golgi complex

D. Cell membrane

E. Nuclear chromatin

2. When conducting a study of the epithelial cells of the oral cavity on the inner surface of the nuclear envelope, rounded bodies are found, which indicate that the cells are taken from the woman's oral cavity. What is the name of such an education?

A. Barr's body

B. Taurus Lyon

C. Decondensed chromatin

D. Euchromatin

E. Taurus Paccini

3. Based on the results of examining the blood stains at the scene of the crime, the forensic medical examiner determined that the blood belonged to the woman. On what grounds was the conclusion made?

A. Presence of nuclear satellites in neutrophils

B. Presence of microcytes and macrocytes

C. Phenomenon of poikilocytosis

D. The presence of specific granules in eosinophils.

E. By the number of erythrocytes.

4. The histological specimen shows a human somatic cell, which is in the metaphase of mitotic division. How many chromosomes are in the metaphase plate, given that each chromosome contains two sister chromatids?

A. 24 chromosomes

B. 92 chromosomes

C. 23 chromosomes

D. 48 chromosomes

E. 46 chromosomes

5. Nucleoli of nuclei are damaged in tissue culture by nuclear irradiation. The restoration of which organelles in the cytoplasm of cells becomes problematic?

A. Ribos

B. Lysosome

C. Endoplasmic reticulum

D. Microtubules

E. Golgi complex

6. The culture of tumor cells was treated with colchicine, which blocks the biosynthesis of tubulin proteins,

which form the spindle of division. What stage of the cell cycle is disturbed in this case?

A. Postsynthetic period

B. Mitosis

C. Synthetic period

D. G-Zero Period

E. Presynthetic period

7. The patient has a tumor in the pyloric region of the stomach. What proteins can inhibit mitotic cell division?

A. Hemoglobin

B. Ribonuclease

C. Lysozyme

D. Keylons

E. Phagocytin

8. The electron micrograph shows a cell in which the nucleolus and nuclear envelope are absent, the chromosomes are freely located in the space of the former nucleus, the centrioles are located at the poles. What phase of the cell cycle is the cell in?

A. In prophase of mitosis

B. In anaphase of mitosis

C. In the metaphase of mitosis

D. In telophase of mitosis

E. In the interphase of mitosis

9. On a histological specimen, the structure is determined, represented by many nuclei in the cytoplasm, bounded by a common membrane. What is the name of such a structure?

A. Syncytium

B. Reticulum

C. Fiber

D. Symplast

E. Cytotrophoblast

10. During the experiment, the cell was treated with a substance that can block the function of the nucleoli. Which cellular function will be affected?

A. Division

B. Protein synthesis

C. DNA synthesis

D. Secretion

E. Lipid synthesis

11. The preparation shows a mitotically dividing cell (diploid) at the anaphase stage. How many chromosomes are in each daughter star?

A. 46 chromosomes

B. 92 chromosomes

C. 23 chromosomes

D. 48 chromosomes

E. 24 chromosomes

12. During cell division, the researcher traced the phase in which the division spindle is formed in the cell, the chromosomes are located in the equatorial plane. What phase is the dividing cell in?

A. In metaphase

B. In anaphase

C. In prophase

D. In telophase

E. In interphase

13. A dividing cell on the preparation. Two groups of chromosomes, centromeres oriented to the poles, and the shoulders to the equator, are at some distance from each other. What phase is the dividing cell in?

A. In telophase

B. In prophase

C. In metaphase

D. In anaphase

E. In interphase

14. A dividing cell on the preparation. At its poles, two tangles of decondensing chromosomes are visible, nuclear envelopes and nucleoli are outlined. What phase is the dividing cell in?

A. In telophase

B. In anaphase

C. In metaphase

D. In prophase

E. In interphase

15. The preparations revealed a decrease in the size of cell nuclei, their compaction, shrinkage, more intense chromatin staining than in unchanged nuclei. What is this phenomenon called?

A. Pycnosis

B. Extrusion

C. Endomitosis

D. Basophilia

E. Chromatolysis

16. The characteristic structures of the nuclear envelope are nuclear pores, which include a number of elements. Which of the following do not apply to them?

A. Peripheral granules

B. Central granule

C. Pore diaphragm

D. Fibrillar filaments

E. Chromatin

17. The cell nucleus is a system of genetic determination and regulation of the processes of cell protein synthesis. What's not in the kernel?

A. Chromatin

B. Plasmolemma

C. Karyoplasm

D. Nucleolemma

E. Nucleolus

18. It is known that polyploidization (formation of cells with an increased DNA content) occurs normally in some specialized differentiated cells. What process is it the result of?

A. Endomitosis

B. Meiosis

C. Polymerization

D. Mitosis

E. Amitoza

19. On a histological specimen in the nucleus of the interphase cell, a structure was examined, the density of which is 1.5 times higher than that of the nucleus. The structure is well stained with basic dyes due to the high RNA content. What is this structure?

A. Polysome

B. Nucleosome

C. Centrosome

D. Nucleolus

E. Heterochromatin

20. An EM photograph shows a structure in the nucleus of an interphase cell, with peripheral granular and central fibrillar components. What is this structure?

A. Polysome

B. Nucleosome

C. Centrosome

D. Nucleolus

E. Heterochromatin

7. Materials for methodological support of self-training of students.

Main literature

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METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Test questions

1. Definition of the concept of fabric. General characteristics of tissues.
2. Classification of fabrics.
3. Sources of tissue development.
4. Epithelial tissue. General characteristics.
5. Morphological classification of epithelial tissues
6. Phylogenetic classification of epithelial tissues
7. Characteristics of monolayer squamous epithelium.
8. Characteristics of monolayer cubic epithelium
9. Characteristics of a single-layer prismatic epithelium.
10. Characteristics of multilayer (pseudo-stratified) epithelium.

Questions for individual work

1. Regularities of origin and evolution of tissues, theory of parallelism and divergent evolution.
2. The concept of cell populations. Stem cells, their properties.
3. Determination and differentiation of cells, their molecular genetic basis.
4. The concept of histogenetic series (dipheron).
5. Cytokeratins as markers of different types of epithelial tissues.
6. Modern ideas about the structure, origin and function of the basement membrane.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. To what type of epithelium, according to this classification, is the single-layer prismatic glandular?

2. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. To what type of epithelium, according to this classification, does the single-layer prismatic limb intestine belong?

3. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. What type of epithelium, according to this classification, is the endothelium?

4. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. What type of epithelium, according to this classification, is the mesothelium?

5. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. To what type of epithelium, according to this classification, is the monolayer cubic urinary tubule?

6. As you know, the endothelium lines the blood vessels. What shape do vascular endothelial cells have?

7. As you know, the endothelium lines the blood vessels. What is the main function of vascular endothelial cells?

8. As you know, through the mesothelium there is a release and absorption of serous fluid. What type, according to the morphological classification, is the mesothelium?

9. The multi-row ciliated epithelium consists of several types of cells. Which of the following cells are not part of it?

10. Epithelial tissues are characterized by a high capacity for regeneration. Which cells in the unilamellar ciliated epithelium are cambial?

11. A 57-year-old man suffering from diabetes mellitus was diagnosed with diabetic microangiopathy due to a significant thickening of the basement membrane of the endothelium. Which of the following functions is not characteristic of the basement membrane?

12. According to the morphological classification, the integumentary epithelium are subdivided into single-layer and multilayer. What is the main criterion underlying this division?

13. According to the morphological classification, single-layer integumentary epithelia are subdivided into single-row and multi-row. What is the main criterion underlying this division?

14. According to the morphological classification, the multi-row prismatic epithelium is monolayer. What is the main criterion for classifying it as single-layer?

15. The epithelium as a tissue is distinguished by a number of morphological and functional characteristics. What feature is not inherent in epithelial tissue?

16. Under experimental conditions, the structures of tight contact between epithelial cells are disturbed. What function of the epithelium will be affected?

17. The inner surface of the blood

vessels is covered with epithelium, which synthesizes substances that prevent the process of blood sedimentation in the vessels. What is the epithelium?

Microslides

1. Single-layer squamous epithelium (mesothelium). Silver impregnation, hematoxylin staining.

2. Single-layer cubic epithelium of the renal tubules. Stained with hematoxylin-eosin.

2a. Monolayer prismatic epithelium of the renal tubules. Hematoxylin-eosin staining.

3. Unilamellar, multilayered ciliated epithelium. Trachea slice. Stained with hematoxylin-eosin.

Specimen for examination 1. Single-layer squamous epithelium (mesothelium) (Fig. 1).

Small magnification. With this magnification, determine on the preparation the area where the cell limits are most clearly visible.

High magnification. Pay attention to the fact that the cells of the mesothelium are flat, polygonal in shape with uneven edges. Some cells contain 2-3 nuclei.

Draw and designate: 1) cell borders ; 2) cell nuclei; 3) a blood vessel under the epithelium.

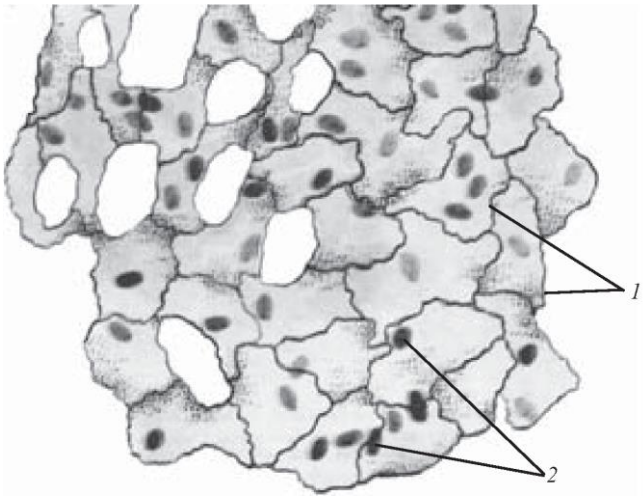


Figure: 1. Simple squamous epithelium (mesothelium). Silver impregnation of staining with hematoxylin. × 400:
1 - cell borders; 2 - cell nuclei.

Specimen for examination 2. Single-layer cuboidal and cylindrical epithelium of the kidney tubules (Fig. 2).

Small magnification. With this magnification of the microscope, find the medulla of the kidney and the transversely cut tubules in it.

High magnification. Consider the shape of the cells. It can be seen that the epithelial cells have approximately the same height and width, which is a characteristic feature of the cubic epithelium. The boundaries of the cells are very expressive, on this preparation they are noticeable in the form of thin lines; intercellular gaps are not visible here. The nuclei of cells are rounded, located approximately in the middle. The cytoplasm of the cells is somewhat granular.

Draw the diagram and designate: 1) single-layer columnar epithelium; 2) simple cuboidal epithelium; 3) connective tissue; 4) blood vessels.

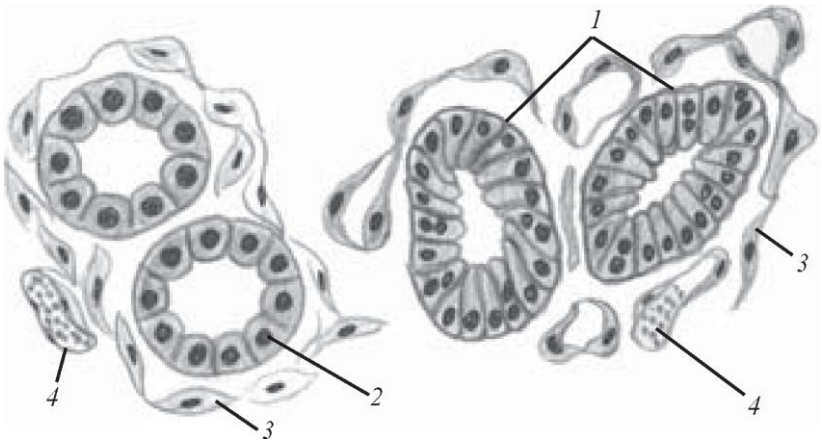


Figure: 2. Simple cuboidal and columnar epithelium of the kidney tubules. Hematoxylin-eosin staining. × 400:
1 - simple columnar epithelium; 2 - simple cuboidal epithelium; 3 - connective tissue; 4 - blood vessels.

Specimen for examination 3. Pseudostratified ciliated epithelium of the trachea (Fig. 3).

Small magnification. Determine the placement of the epithelium in relation to other tissues. It can be seen that the epithelium is located on the inner surface of the trachea.

High magnification. Find ciliated cells, goblet cells, short insertion cells, long insertion cells, and basement membrane. In ciliated cells, the nuclei are located in the upper row. Goblet cells have a light cytoplasm. The nuclei of the short and long intercalated cells lie closer to the basement membrane.

Sketch the preparation. In the figure, designate: 1) epithelium; a) cilia; b) rows of nuclei; 2) the goblet cell; 3) connective tissue; 4) glands; 5) hyaline cartilage.

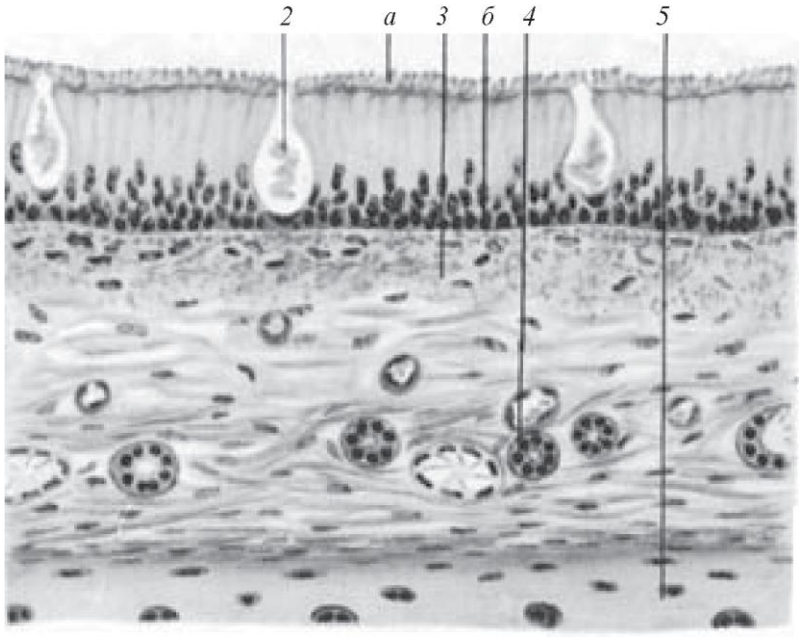


Figure: 3. Pseudostratified ciliated epithelium of the trachea. Hematoxylin-eosin staining. × 600:
1 - epithelium (a - cilia b - rows of nuclei) 2 - goblet cell; 3 - connective tissue; 4 - glands; 5 - hyaline cartilage

Electron micrographs

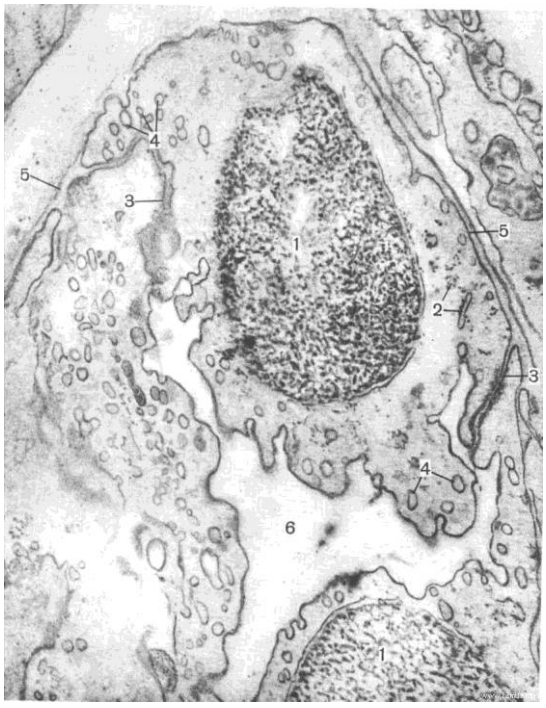
1. Endothelial cells.

2. Connections of epithelial cells by the type of "lock".

3. Different contacts of epithelial cells.

Endotheliocyte (blood capillary)

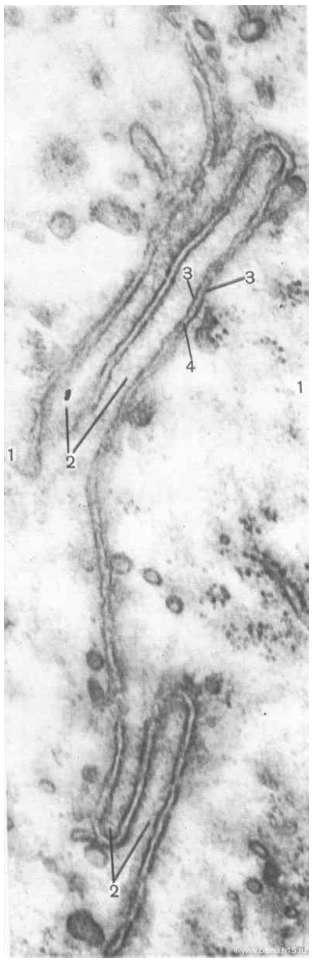
Pinocytosis. Electronic microphotogram of endothelial cells of blood capillary of rat lymphatic follicle. × 30 000



1 – nuclei of endothelial cells; 2 – endoplasmic reticulum; 3 – endothelial cell-to-cell junctions; 4 – pinocytic vesicles; 5 – basal lamina; 6 – lumen of the blood capillary.

Adherens junctions between epithelial cells

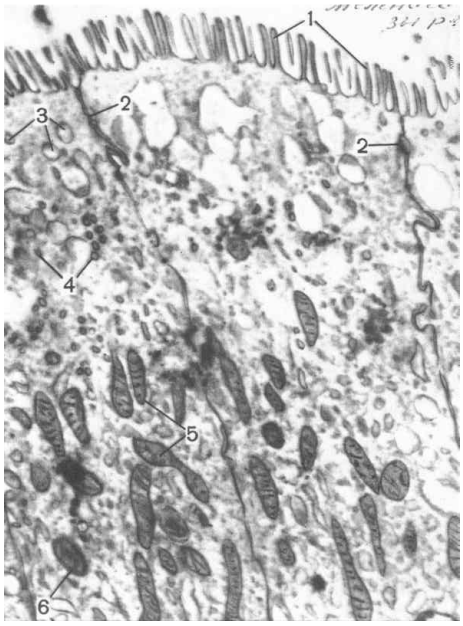
The type of junctions between the cells. Electronic microphotogram of the cells of ciliated epithelium of rat bronchus. × 21 500



1 - cytoplasm; 2 – adherens junction; 3 – membranes of the cells; 4 – intermembrane spaces.

Different junctions between epithelial cells (apical portion of the gallbladder cells)

Epithelium of the mucosa of the gallbladder of a dog. Electronic microphotogram. × 16 000



1 - microvilli on the apical portion of the cell; 2 - borders of two cells; 3 – pinocytic vesicles; 4 – secretory granules; 5 - mitochondria; 6 – lysosomes.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. On an electron micrograph of a fragment of the inner lining of a vessel, cells are identified that lie on the basement membrane and are connected with each other using desmosomes and tight contacts. Name these cells.

A. Endothelium.

B. Mesothelium.

C. Epidermis.

D. Epithelioreticular cells.

E. "Coastal" macrophages.

2. After inhalation of caustic vapors, a part of the ciliated epithelial cells of the bronchi died in a chemical worker. Due to what cells of the mucous membrane will the regeneration of ciliated cells take place?

A. Fibroblasts

B. Goblet cells

C. Endocrine cells

D. Langengars cells

E. Interstitial cells

3. After inhalation of corrosive vapors, a chemical worker has increased mucus secretion in the respiratory tract. Which epithelial cells of the respiratory tract are involved in moisturizing the mucous membrane?

A. Fibroblasts

B. Goblet cells

C. Endocrine cells

D. Langengars cells

E. Insertion cells

4. The inner shell of the vessel (intima) is lined by the epithelium from the inside. Name it.

A. Mesothelium

B. Endothelium.

C. Epidermis.

D. Transitional epithelium.

E. Multi-row epithelium.

5. On the histological preparation of the trachea as part of the multi-row ciliated epithelium, low cells are visible that do not reach the apical surface of the epithelium, in some of the cells figures of mitosis are visible. What is the function of these cells?

A. Kambialnaya.

B. Barrier.

C. Supporting.

D. Endocrine.

E. Exocrine.

6. In a conditional experiment, the structure of tight contact between epithelial cells was destroyed. What function of the epithelium will be affected?

A. Receptor

B. Transepithelial transport

C. Insulating, barrier

D. Secretory

E. Excretory

7. A patient with dry pleurisy auscultates pleural friction noise. With the defeat of what type of epithelium is this symptom noted?

A. Endothelium

V. Urotelia

C. Bordered epithelium

D. Transitional epithelium

E. Mesothelium

8. What type of contacts between cells of the epithelial layer prevents the penetration of molecules from the external environment into the internal one?

A. Schelevoy

B. Contact by lock type

S. Desmosoma

D. Dense

E. Semidesmosome

9. A patient with acute rhinitis has hyperemia and dryness of the nasal mucosa. What cells of the mucous epithelium are responsible for its hydration?

A. Goblet

B. Insert

C. Microvillous

D. Basal

E. Endocrine

10. On a film histological preparation of the epithelium impregnated with silver salts, polygonal cells with jagged jagged edges are visible, some of them contain 2-3 nuclei. What is the epithelium

A. Transitional

B. Mesothelium of the peritoneum

C. Unilamellar cubic epithelium

D. Single row ciliated

E. Multi-row ciliate

11. Epithelial cells are connected to each other through various contacts. What type of intercellular contacts ensures the transfer of ions and low-molecular substances from cell to cell?

A. Dense

V. Desmosoma

C. Semidesmosome

D. Slit

E. All of the above

12. In the polarly differentiated columnar epithelium, which develops from the intermediate mesoderm, some of the cells in the apical section carry structures containing the axoneme. Indicate the epithelium.

A. Limbate intestine

B. Glandular stomach

C. Atrial trachea

D. Ciliated oviduct

E. Rimmed tubules of the kidney

13. On the transverse section of the kidney tubules, epithelial cells are visible, which lie on the basement membrane, in one layer. What is the epithelium?

A. Single layer cubic

B. Single-layer cylindrical edged

C. Mesothelium

D. Endothelium

E. Single-layer cylindrical ferruginous

14. On a histological specimen of the wall of the small intestine, prismatic epithelial cells are visible; microvilli are visible on the apical surface. The epithelium performs the function of absorption. What is the epithelium?

A. Single layer cubic

B. Single-layer cylindrical edged

C. Mesothelium

D. Endothelium

E. Single-layer cylindrical ferruginous

15. On the histological preparation of the trachea epithelium is visible, most of the cells of which have a cylindrical shape with ciliated cilia in the apical part. Goblet cells, basal and intercalated, are located between them. What is the epithelium?

A. Single layer cubic

B. Pseudo-layered cylindrical ciliated

C. Mesothelium

D. Endothelium

E. Single-layer cylindrical ferruginous

16. Epithelial tissue is bordered by connective tissue. What is the structure in between?

A. Amorphous substance

B. Collagen fibers

C. Elastic membrane

D. Cytolemma

E. Basement membrane

17. Epithelial tissues have different functions. Which of the following functions is not typical for them?

A. Secretory

B. Protective

C. Trophic

D. Covering

E. Contractile

18. The mucous membrane of the stomach protects its wall from the rough influence of food lumps and the digestive action of gastric juice. What morphological type of epithelial tissue is the epithelium of the gastric mucosa?

A. Single layer flat

B. Single layer cubic

C. Single-layer cylindrical rim

D. Multi-row ciliate

E. Single-layer cylindrical ferruginous

19. In the oviducts, the advancement of the germ cell is provided by the movement of the cilia of epithelial cells. What morphological type of

epithelial tissues does the oviduct epithelium belong to?

A. Single layer flat

B. Single layer cubic

C Single-layer cylindrical ferruginous

D. Multi-row ciliate

E. Single layer cylindrical ciliated

20. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin. What are the criteria for this classification?

A. Layering

B. Cell shape

C. Polar differentiation

D. Functions

E. Origin

7. Materials for methodological support of self-training of students.

Main literature

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5. Napkhanyuk V.K. Fundamentals of cytology, general histology and embryology (course of lectures). Odessa. 1999.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. Classification of stratified epithelium.

2. Characteristics of stratified squamous non-keratinizing epithelium.

3. Characteristics of stratified squamous keratinizing epithelium.

4. Characteristics of the transitional epithelium.

5. Glandular epithelium. Characteristics of glandulocytes.

6. Secretion. Phases of the secretory cycle.

6. Glands. Classification of exocrine glands by structure.

Questions for individual work

1. Endocrine, exocrine glands.

2. Types of secretion according to the method of secretion excretion.

3. Features of physiological regeneration of epithelial tissues.

4. Features of reparative regeneration of epithelial tissues.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. The stratified squamous non-keratinizing epithelium lines the outside of the cornea of the eye, the oral cavity and the esophagus. Several layers are distinguished in it. Name the number of these layers.

2. Endocrine glands produce highly active substances - hormones. Which of the following signs are characteristic of the endocrine glands?

3. At the place of excretion of the secretion, the glands are divided into endocrine and exocrine. They are also distinguished by some morphological features. Which of the following signs is characteristic of the endocrine glands?

4. At the place of excretion of the secretion, the glands are divided into endocrine and exocrine. They are also distinguished by some morphological features. Which of the following signs are characteristic of exocrine glands?

5. The chemical composition of the secretion produced by the exocrine glands may be different. How do exocrine glands differ depending on the properties of the secreted secretion?

6. Secretion is a process of formation and excretion of substances synthesized by the cell outside its limits. It consists of several stages. Which of the following stages are related to the secretory cycle?

7. In some cases, changes in the normal expression of specific proteins that form tonofilaments are an important diagnostic sign of malignant degeneration of the epithelium. Name these proteins:

8. The patient was diagnosed with pemphigus vulgaris - a severe autoimmune disease of the skin and mucous membranes, in which epithelial cells lose communication with each other due to antibodies damaging the desmosome. What specific proteins do desmosomes contain?

9. The process of keratinization of the epithelium consists in the transformation of its living epithelial cells into horny scales - mechanically strong and chemically stable postcellular structures. What are the main processes occurring in cells during keratinization:

10. The patient has hyperkeratosis - a skin condition in which the process of rejection of the corneous scales of the epidermis is disturbed. What is the physiological mechanism of the removal of cells of the superficial layer of stratified epithelium:

11. The stratified cubic epithelium, usually two-layered, is quite rare in the human body - in the excretory ducts of some glands, in particular:

12. The stratified prismatic epithelium, usually two-layered, is quite rare in the human body - in the excretory ducts of some glands, in particular:

13. The stratified cubic and prismatic epithelium in the human body is quite rare - usually in the excretory ducts of some glands. What type, according to the ontophylogenetic classification, are these epithelia?

14. In accordance with the morphological classification, exocrine glands are simple and complex. What criterion is the basis for such a unit?

15. In accordance with the morphological classification, exocrine glands are branched and unbranched. What criterion is the basis for such a unit?

16. In accordance with the morphological classification, exocrine glands are alveolar, tubular and alveolar-tubular. What criterion is the basis for such a unit?

17. In the histopreparation, the end sections of the glands formed by cells with a centrally located round nucleus and basophilic cytoplasm are determined. Determine the type of end sections.

18. In a limited area of the epidermis due to trauma, there are no layers, except for the stratum corneum. Name the cells that are the main source of regeneration.

19. A patient has damaged the epithelium of the mucous membrane due to a burn of the esophagus with vinegar essence. What cellular structures of the integumentary epithelium are the source of reparative regeneration?

20. During the fall, the child injured the skin of the palm. Which epithelium was damaged?

Microslides

1. Stratified squamous non-keratinizing epithelium. A slice of the cornea of the eye. Stained with hematoxylin-eosin.

2. Stratified squamous keratinizing epithelium of the skin of the finger. Stained with hematoxylin-eosin.

3. Transitional epithelium of the urinary bladder. Stained with hematoxylin-eosin.

Specimen for examination 1. Stratified squamous non-keratinizing epithelium of the cornea of the eye (Fig. 1).

Small magnification. With this magnification, find a stratified epithelium on the outer surface of the cornea.

High magnification. The basement membrane is clearly visible, on which one layer of low prismatic cells is located - the basal layer. The nuclei of the cells of the basal layer are oval, located vertically. Along the basal layer, there are several layers of cells of irregular shape, having cytoplasmic outgrowths, forming a layer of spiny cells. The nuclei of these cells are round. Externally, several layers of cells are placed, which form the surface layer of flat cells. Their nuclei are compacted and parallel to the surface of the epithelium. Sketch the preparation.

In the figure, designate: 1) epithelium: a - basal layer; b - a layer of spiny cells; c - a layer of flat cells, 2) basement membrane; 3) connective tissue.

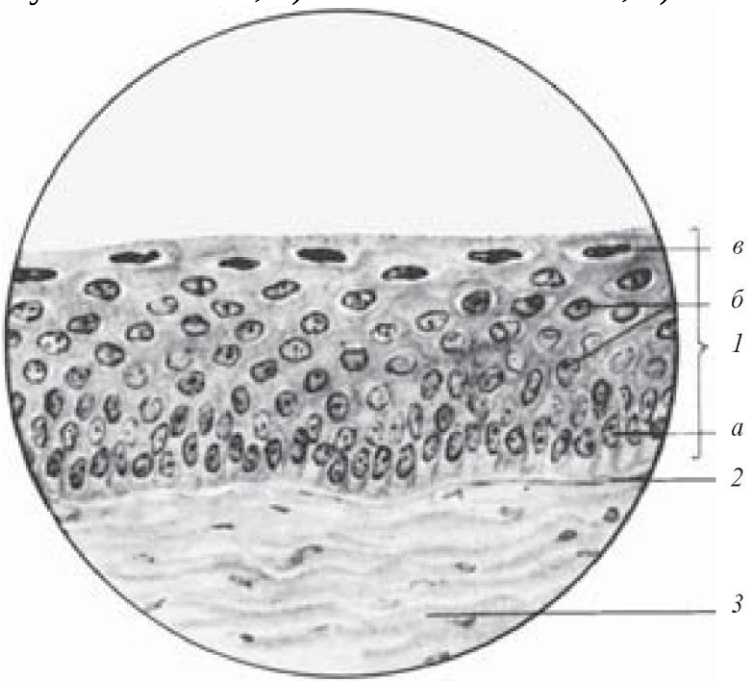


Figure: 1. Stratified squamous non-keratinizing epithelium of the cornea of the eye. Hematoxylin-eosin staining. × 800:

1 - epithelium (a - basal layer, b - a layer of spiny cells, c - a layer of flat cells) 2 - basement membrane; 3 - connective tissue

Specimen for examination 2. Stratified squamous keratinizing epithelium of the skin of a finger (Fig. 2).

Small magnification. Consider the drug. With this magnification find the epidermis of the skin of the finger.

Great magnification. The basal layer formed by the cells is clearly visible; they lie on the basement membrane, followed by the prickly layer, the cells of which on their surface have small cytoplasmic outgrowths by which they are connected. The

granular layer is distinguished by a dark color, the cells of its compacted form, containing keratohyalin grains in the cytoplasm, which are stained dark purple. The shiny layer on the preparation is light in color and looks homogeneous. The outer layer is stratum corneum, represented by flattened cells (horny scales). Sketch the preparation.
In the figure, designate: 1) epithelium: a - basal layer; b - a layer of spiny cells; c - granular layer; d - shiny layer; d - stratum corneum; 2) connective tissue.

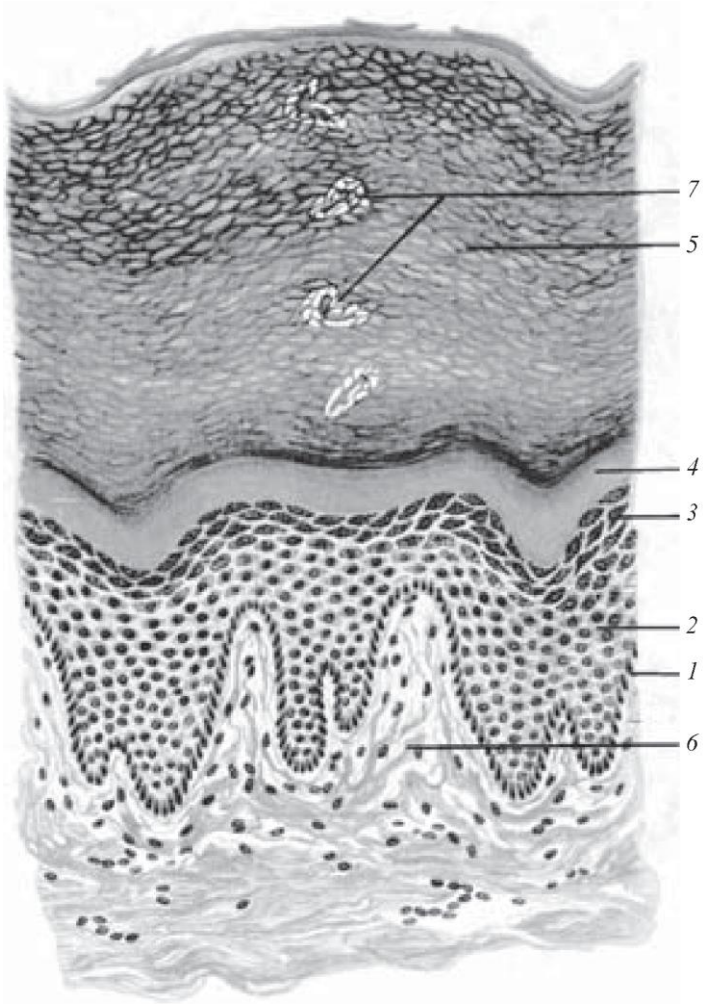


Figure: 2. Stratified squamous keratinizing epithelium of the skin of the finger. Hematoxylin-eosin staining. × 600:
1 - basal layer; 2 - a layer of spiny cells; 3 - granular layer; 4 - shiny layer; 5 - stratum corneum; 6 - connective tissue; 7 - excretory duct of the sweat gland

Specimen for examination 3. Transitional epithelium of the urinary bladder (Fig. 3).
Small magnification. With this magnification, find the transitional epithelium on the inner surface of the bladder.
High magnification. Small basal cells are clearly visible, some of which lie directly on the basement membrane and form the basal layer, others are pushed back to the

rows located above and form an intermediate layer. The surface layer consists of large pear-shaped cells with intensely pink cytoplasm. Draw and designate: 1) epithelium: a - cells of the basal layer; b - cells of the intermediate layer; c - cells of the surface layer; 2) connective tissue; 3) a blood vessel.

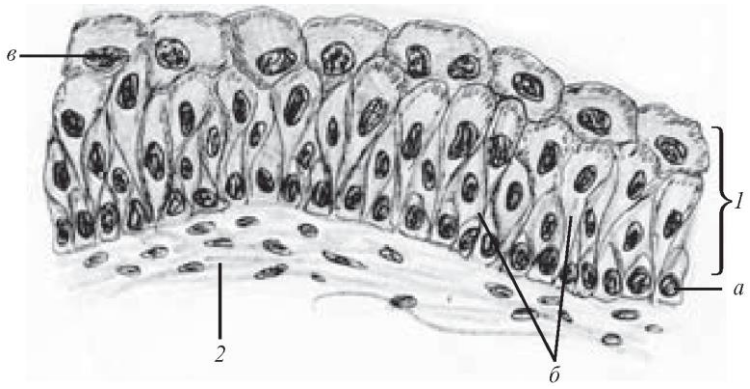
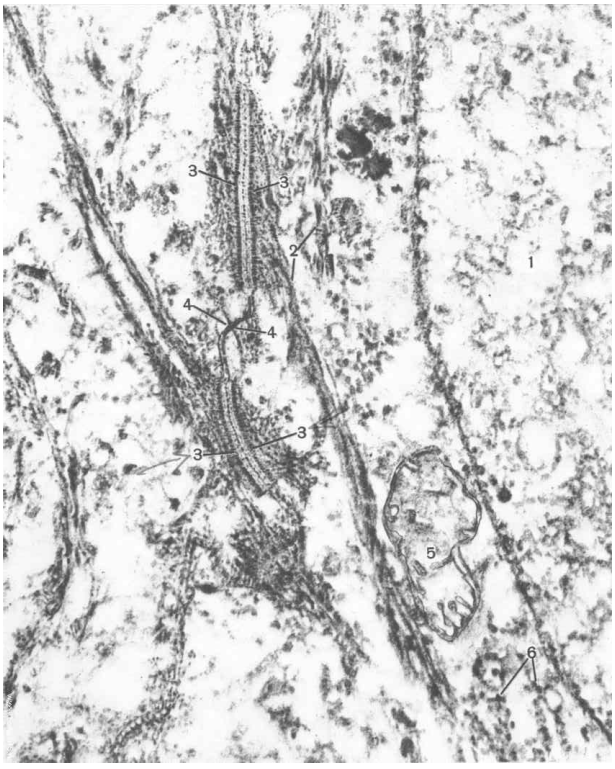


Figure: 3 Transitional epithelium of the bladder. Hematoxylin-eosin staining. × 600: 1 - epithelium (a - cells of the basal layer; b - cells of the intermediate layer; c - cells of the surface layer) 2 - connective tissue

Electron microphotogram

Desmosomes

Part of the cells of stratum spinosum of human abdominal skin. Electronic microphotogram. × 40 000



1 - nucleus; 2 – thin bundles of tonofilaments; 3 - desmosomes; 4 – cell membrane; 5 - mitochondria; 6 – ribosomes.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. According to the morphological classification, stratified integumentary epithelia are subdivided into flat, cubic and prismatic. What is the main criterion underlying this division?

A. Shape of basal epithelial cells

B. Form of intermediate epithelial cells

C. Shape of superficial epithelial cells

D. Height of basal epithelial cells

E. Location of epithelial cells on the basement membrane

2. The transitional epithelium lining the urinary tract, according to the morphological classification, refers to multilayer. What feature allows us to classify it as a stratified epithelium?

A. Connection of cells of the basal layer with the basement membrane

B. Communication of cells of the intermediate layer with the basement membrane

C. Communication of cells of the surface layer with the basement membrane

D. Variability of the shape of surface epithelial cells

E. Lack of communication of the surface layer with the basement membrane

3. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. To what type of epithelium, according to this classification, is the stratified squamous keratinizing epithelium?

A. Epidermal

B. Enterodermal

C. Celonephrodermal

D. Ependymoglial

E. Angiodermal

4. There is an ontophylogenetic classification of epithelial tissues, created by N.G. Khlopin, which is based on the origin of the epithelium. To what type of epithelium, according to this classification, is the multilayered transitional epithelium?

A. Epidermal

B. Enterodermal

C. Celonephrodermal

D. Ependymoglial

E. Angiodermal

5. After receiving a minor skin injury, the child's scratch disappeared after 10 days. Cambial elements of which layer of the epidermis ensured its reparative regeneration?

A. Basal layer

B. Thorny layer

C. Granular layer

D. Stratum corneum

E. Shiny coat

6. In a histological specimen of a biopsy of the epidermis of the skin of a healthy adult, dividing cells are visible in the basal layer. What process does these cells provide?

A. Physiological regeneration.

B. Differentiation.

C. Adaptation.

D. Reparative regeneration.

C. Apoptosis

7. The preparation shows cylindrical secretory cells, their tops protrude into the lumen. Some of them are destroyed. Secretory granules are determined at the tops of the cells. What type of secretion is it?

A. Simple

B. Difficult

S. Merokrinovy

D. Apocrine

E. Golokrinovy

8. In a conditional experiment, all layers of the epidermis were removed from a small area of the skin. How is regeneration carried out?

A. Due to the papillary layer of the dermis.

B. Due to the multiplication of cells of the basal

prickly layers.

C. Due to the multiplication of cells of the growth

layer from the surrounding intact skin.

D. Due to the reticular layer of the dermis.

E. Due to the papillary and reticular layer

dermis.

9. In the experiment, the permeability of the basement membrane of the stratified squamous epithelium was significantly reduced. How will this affect his life?

A. The transport of substances from the cell will be disrupted

cage.

B. Metabolism will be disrupted, keratinization will accelerate and be disrupted.

C. Autolysis will develop.

D. Dedifferentiation will occur.

E. Reparative processes will intensify.

10. The secretory section of the gland is visible on the skin preparation. It was found that, with distance from the basement membrane, the cells gradually accumulate secretion, pycnosis and loss of the nucleus, the central zone of the terminal section contains secretion and cellular detritus. What type is this gland secreting?

A. Merokrinovy.

B. Macro-apocrine

C. Micro-apocrine

D. Holocrine

E. Amfikrinovy

11. The electron diffraction pattern of the secretory cell contains all organelles. The Golgi apparatus with a large number of vacuoles and small vesicles is well developed. The apical pole contains secretory vacuoles, some of which open to the cell surface by exocytosis. Plasmolemma is not broken. What type of secretion does this structure correspond to?

A. Merokrinovy.

V. Apocrinovy.

C. Simple.

D. Difficult.

E. Golokrinovy

12. As a result of examination of the patient, corneal erosion was established - the absence of superficial and prickly layers of the epithelium. Which cells will ensure the regeneration of damaged epithelium?

A. Basal

B. Stratum corneum cells

C. Cells of the granular layer

D. Cells of the lustrous layer

E. Cells of the surface layer

13. The glandular cell, specialized for the synthesis of a significant amount of protein with its subsequent secretion, contains well-developed:

A. Smooth endoplasmic reticulum, Golgi complex

B. Free ribosomes, mitochondria

C. Granular endoplasmic reticulum, Golgi complex

D. Smooth endoplasmic reticulum

mitochondria

E. Lysosomes, smooth endoplasmic

network

14. In the lustrous layer of the stratified squamous keratinizing epithelium, there are cells whose substance has birefringence. The

presence of what substance determines this property of the cells of the shiny layer?

A. Keratogialin

V. Keratin

S. Laminin

D. Cytokeratin

E. Eleidin

15. Physiological regeneration of the epidermis occurs every 3-4 weeks. In which layer of the stratified squamous keratinizing epithelium are stem cells?

A. Basalny

V. Zernisty

S. Shipovatom

D. Rogov

E. Brilliant

16. Five layers are distinguished in the epithelium of the skin of the fingers, palms and soles. What layer is missing in the epithelium of the remaining areas?

A. Brilliant

V. Rogovoy

C. Basalny

D. Spiny

E. Grainy

17. Physiological regeneration of the epithelium occurs due to the death of old and multiplication of new epithelial cells. In which layer of the stratified squamous keratinizing epithelium does the death and rejection of epithelial cells occur?

A. In prickly

B. In brilliant

C. Granular

D. Basal

E. In the horn

18. According to the morphological classification, the integumentary epithelium is divided into single-layer and multilayer. What criterion determines the stratification of the epithelium?

A. Communication of all cells with the basement membrane

B. Different cell shapes

C. Communication of cells of the basal layer with the basement membrane

D. Arrangement of epithelial nuclei in several rows

E. Arrangement of cells in several layers

19. According to the morphological classification, the integumentary epithelium is divided into single-layer and multi-layer. What criterion determines monolayer epithelium?

A. Communication of all cells with the basement membrane

B. Different cell shapes

C. Communication of cells of the basal layer with the basement membrane

D. Arrangement of epithelial nuclei in several rows

E. Arrangement of cells in several layers

20. According to the morphological classification, the single-layer epithelium is divided into single-row and multi-row. What criterion determines the multi-row epithelium?

A. Communication of all cells with the basement membrane

B. Different cell shapes

C. Communication of cells of the basal layer with the basement membrane

D. Arrangement of epithelial nuclei in several rows

E. Arrangement of cells in several layers

7. Materials for methodological support of self-training of students.

Main literature

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METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Test questions

1. General characteristics of the tissues of the internal environment
2. Blood. General morphological and functional characteristics of blood.
3. Blood plasma. Blood plasma composition.
4. Erythrocytes. Structure. Functions.
5. Platelets. Structure. Functions.
6. Hemogram, its significance for practical medicine.

Questions for individual work.

1. Characterization of blood plasma proteins.
2. Ultramicroscopic structure of erythrocyte plasmolemma.
3. Features of the structure of reticulocytes.
4. Age-related changes in the hemogram.
5. The effect of environmental factors on the blood.

6.2. Materials for the methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks.

1. With insufficient intake of iron in the human body, iron deficiency anemia develops. What changes will happen to red blood cells?

2. If the skin was damaged, bleeding from the wound surface was longer than normal. What platelet enzyme deficiency can cause this phenomenon?

3. Blood plasma is an intercellular substance of liquid consistency. What is the volume of blood plasma?

4. The analysis of the patient's blood revealed microcytic anemia - a significant predominance of microcytes over normocytes. What is the average diameter of normocytes?

5. Under physiological conditions, along with mature forms of erythrocytes, the blood contains a small number of young forms, poor in hemoglobin - reticulocytes. How is the cytoplasm of reticulocytes stained?

6. Under physiological conditions, along with mature forms of erythrocytes, the blood contains a small number of young forms, poor in hemoglobin - reticulocytes. What is the percentage of reticulocytes from the total number of red blood cells?

7. Under physiological conditions, along with mature forms of erythrocytes, the blood contains a small number of young forms - reticulocytes. What is not typical for reticulocytes:

8. Under physiological conditions, along with mature forms of erythrocytes, the blood contains a small number of young forms, poor in hemoglobin - reticulocytes. What method is usually used to identify these cells?

9. Under physiological conditions, along with mature forms of erythrocytes, the blood contains a small number of young forms, poor in hemoglobin - reticulocytes. What dye is commonly used to detect these cells?

10. Fetal hemoglobin (HbF) predominates in fetal blood. In the blood of a newborn, it is 80%. What property determines its high content in the blood of the fetus?

11. In accordance with the features of the size, shape and color of the granulomere and hyalomera, platelets are divided into several types. Indicate which of the following is a platelet:

12. In accordance with the features of the size, shape and color of the granulomere and hyalomera, platelets are subdivided into several types. Indicate which type of the listed does not apply to platelets:

13. Plasmolemma of the erythrocyte, possessing significant plasticity, resistance, selective permeability, is characterized by a special composition of chemical components. What is on the outer surface of the erythrocyte membrane:

14. Plasmolemma of the erythrocyte, possessing significant plasticity, allows the cell to deform and easily pass through narrow capillaries. It owes this property to membrane proteins associated with the membrane cytoskeleton. What protein is not included in this system?

15. Platelets - postcellular blood elements responsible for thrombus formation and blood coagulation processes. Morphologically distinguish between the central part and the peripheral. Peripheral is called:

16. Platelets - postcellular blood elements responsible for thrombus formation and blood coagulation processes. Morphologically distinguish between the central part and the peripheral. The central one is called:

17. Platelets - postcellular blood elements responsible for thrombus formation and blood coagulation processes. Morphologically distinguish between the central part and the peripheral. The peripheral part contains:

18. Platelets - postcellular blood elements responsible for thrombus formation and blood coagulation processes. Morphologically distinguish between the central part and the peripheral. The central part contains everything except:

Micropreparations

1. A blood smear from a frog. Coloring hematoxylin-eosin.

2. Human blood smear. Staining according to Romanovsky-Giemsa.

Specimen for examination 1. A blood smear from a frog (Fig. 1).
Small magnification. With this increase, we choose a place where there are more red blood cells.
High magnification. Examine and sdraw red blood cells. Frog red blood cells are significantly larger than mammalian red blood cells. They are oval in shape. The rod-shaped nucleus of erythrocytes is strongly colored, the cytoplasm of the erythrocyte is colored bright red due to oxyphilia.
Designate: 1) the nucleus of the erythrocyte; 2) erythrocyte cytoplasm.

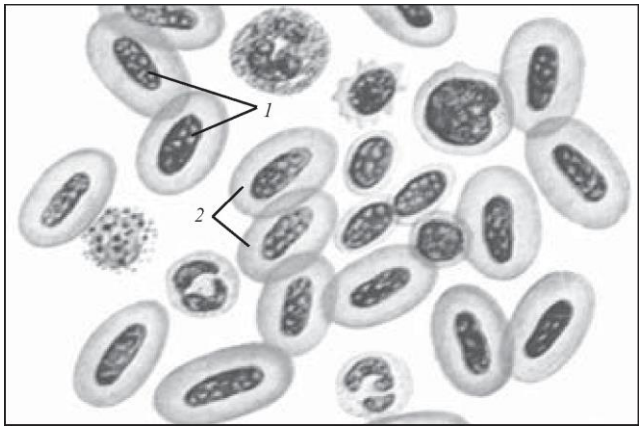


Figure: 1. A blood smear from a frog. Hematoxylin-eosin staining. × 400: 1 - erythrocyte nucleus; 2 - erythrocyte cytoplasm

Specimen for examination 2. Human blood smear (Fig. 2).
Small magnification. Choose a place on the specimen with well-fixed erythrocytes.
High magnification. Consider and drae the specimen. Erythrocytes stained with eosin pink. Oxyphilia of erythrocytes is caused by hemoglobin, which saturates mature erythrocytes. They are shaped like a biconcave disc. On the smear, indentations in the center of the erythrocyte are clearly visible - the place where the nucleus used to be. This place is lighter on the preparation.

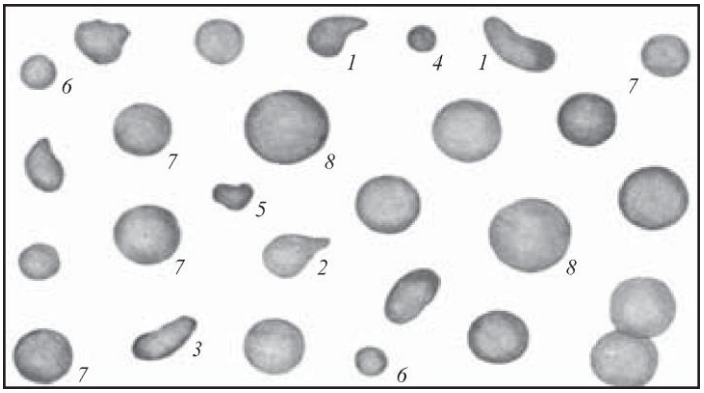


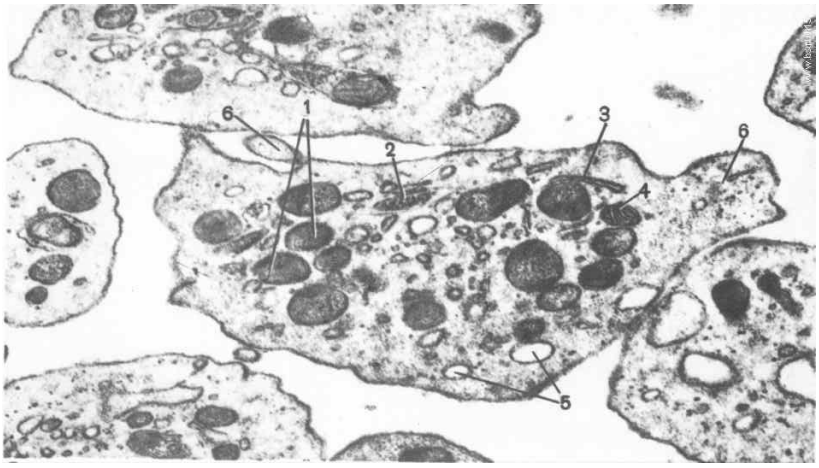
Figure: 2. Erythrocytes of human blood. Romanovsky-Giemsa staining. × 900:

1, 2, 3 - poikilocytes (erythrocytes of atypical shape, which differ from round) 4-6 - microcytes (erythrocytes of the correct rounded shape, but not of the usual size) 7 - normocytes (erythrocytes of normal shape and size) 8 - megalocytes (erythrocytes of large size)

Electron microphotogram

1.Platelets

Platelets. Electronic microphotogram of ultramicroscopic section of rat platelet. × 35 000



1 - α-granules; 2 – glycogen inclusions; 3 – endoplasmic reticulum; 4 - mitochondria; 5 - vacuoles; 6 – processes of platelet.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. The analysis of blood, due to the simplicity of obtaining its samples from the patient and the high diagnostic value of the results, has become widespread in medicine. What is not typical for blood as tissue:

A. Mesenchymal origin

B. Is a tissue of the internal environment

C. is a type of connective tissue

D. makes up 6-8% of human body weight

E. Does not have intercellular substance

2. The analysis of blood, due to the simplicity of obtaining its samples from the patient and the high diagnostic value of the results, has become widespread in medicine. What is not typical for blood as tissue:

A. Contains cells

B. Contains postcellular structures

C. Contains non-cellular fibers

D. Contains 55-60% of intercellular substance

E. Circulates in a closed vascular system

3. The analysis of blood, due to the simplicity of obtaining its samples from the patient and the high diagnostic value of the results, has become widespread in medicine. What function is not characteristic of blood:

A. Trophic

B. Support

C. Regulatory

D. Excretory

E. Respiratory

4. The analysis of blood, due to the simplicity of obtaining its samples from the patient and the high diagnostic value of the results, has become widespread in medicine. What function is not characteristic of blood:

A. Transport

B. Homeostatic

C. Thermoregulatory

D. Secretory

E. Gas exchange

5. A blood test revealed a low hemoglobin content. What blood function is impaired in this case?

A. Gas exchange

B. Transport of hormones

C. Securing immunity

D. Blood coagulation

E. Transport of nutrients

6. Blood includes corpuscles and plasma - a liquid intercellular substance. What is the name of the indicator that evaluates the volume of formed elements in relation to the volume of blood:

A. Hemogram

B. Leukogram

C. Myelogram

D. Hematocrit

E. ESR

7. Biochemical study of blood plasma carries valuable diagnostic information, since plasma contains components important for life. what characteristic is not characteristic of plasma:

A. Buffer systems

B. Clotting factors

C. Participation in gas exchange

D. Oxygen binding

E. Immunoglobulins

8. Biochemical study of blood plasma carries valuable diagnostic information, since plasma contains components important for life. Which

of the following proteins are not plasma?

A. Albumin

B. Globulins

C. Fibrinogen

D. Hemoglobin

E. Components of Complement

9. The results of a blood test, reflecting the content of individual uniform elements, are called:

A. Hemogram

B. Hematocrit

C. Myelogram

D. Leukogram

E. ESR

10. In the blood of a 26-year-old man, 18% of erythrocytes are spherical, flat, domed and spinous. The rest of the erythrocytes were in the form of biconcave discs. What is the name of this phenomenon?

A. Physiological poikilocytosis

B. Pathological poikilocytosis

C. Physiological anisocytosis

D. Pathological anisocytosis

E. Erythrocytosis

11. In the patient's blood, 12.5% of erythrocytes with a diameter of more than 8 μm were detected, 12.5% of erythrocytes were less than 6 μm, the rest of the erythrocytes had a diameter of 7.1 - 7.9 μm. Yak called such a phenomenon?

A. Physiological anisocytosis

B. Pathological anisocytosis

C. Physiological poikilocytosis

D. Pathological poikilocytosis

E. Erythrocytosis

12. The use of aspirin is known to impair platelet function. What changes in platelets will be observed?

A. Violation of aggregation

B. Decrease in quantity

C. Decrease in the number of mitochondria

D. Shortened life expectancy

E. Increase in the number of old and degenerative forms

13. The patient's blood was taken for analysis. Her data show that 35% of red blood cells are irregular. What is this condition called?

A. Pathological poikilocytosis

B. Anisocytosis

C. Physiological poikilocytosis

D. Macrocytosis

E. Microcytosis

14. The analysis of the patient's blood showed a sharp decrease in the

hemoglobin content. What blood function is impaired in this case?

A. Respiratory.

B. Transport.

C. Homeostatic.

D. Protective.

E. Trophic.

15. The diagnostic laboratory examines the blood taken for analysis from a patient who has suffered massive bleeding. What changes in quantitative composition should be expected?

A. Decrease in the number of reticulocytes

B. Decrease in the number of red blood cells

C. Decrease in the number of monocytes

D. Decreased lymphocyte count

E. Increase in the number of segmented neutrophils

16. After CO poisoning, the victim developed respiratory failure. What type of hemoglobin formation disorder led to the development of this pathology?

A. Oxyhemoglobin

B. Carbhemoglobin

C. Carboxyhemoglobin

D. HbA

E. HbF

17. When blood vessels are damaged, bleeding stops spontaneously. What is the blood cell that is primarily involved in blood coagulation?

A. Platelets

B. Leukocytes

C. Erythrocytes

D. Lymphocytes

E. Neutrophils

18. The patient was mistakenly injected into a vein with a hypotonic solution. What changes can happen to red blood cells?

A. Increase in the number of red blood cells

B. Breakdown of erythrocytes (hemolysis)

C. Pathological anisocytosis

D. Pathological poikilocytosis

E. Breakdown of platelets

19. A patient with complaints of shortness of breath and rapid fatigability was found to have a sharp decrease in the number of erythrocytes. What is this phenomenon called?

A. Hemolysis

B. Anemia

C. Anisocytosis

D. Poikilocytosis

E. Erythrocytosis

20. When the skin was damaged, bleeding from the wound surface was longer than normal. The lack of which blood cells can lengthen the bleeding time?

A. Platelets

B. Erythrocytes

C. Reticulocytes

D. Monocytes

E. B-lymphocytes

7. Materials for methodological support of self-training of students.

Main literature

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2. Napkhanyuk V.K., Servetsky K.L. Workshop on cytology, general histology and embryology. Tutorial. Odessa, 1999.

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4. Almazov IV, Sutulov L.S. Atlas of Histology and Embryology. M .: Medicine, 1978.

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METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Test questions

1. General characteristics and classification of leukocytes.
2. Characteristics of neutrophilic granulocytes.
3. Characteristics of eosinophilic granulocytes.
4. Characteristics of basophilic granulocytes.
5. Characteristics of lymphocytes.
6. The structure of lymphocytes in light and electron microscopy.
7. Immunological classification of lymphocytes.
8. Morphofunctional characteristics of monocytes.
9. Leukocyte formula. Its importance for practical medicine
10. The value of blood agranulocytes in cellular and humoral immunity.

Questions for individual work.

1. The concept of the macrophage system of the body.
2. Age-related changes in blood.
3. The effect of environmental factors on the blood.
4. Lymph.
5. Leukocyte formula. Its importance for practical medicine.
6. Age-related changes in blood.
7. The effect of environmental factors on the blood.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. When examining a histological preparation, neutrophils are determined in the connective tissue. What is the function of these cells, penetrating from the blood into the tissues?

2. Clinical examination of a 37-year-old patient revealed an acute infectious disease accompanied by leukocytosis. An increase in what forms of leukocytes can be detected in a patient's blood smear?

3. In the blood of a sick child (10 years old), 10% of eosinophilic granulocytes were found with a normal total number of leukocytes. This may indicate:

4. When analyzing the blood, the laboratory assistant concluded that the blood belongs to a woman. The structural features of what shaped elements makes it possible to make such a conclusion?

5. When examining a blood smear of a patient, cells were found that make up 0.5% of the total number of leukocytes, have an irregular nucleus shape, and metachromatically colored granules in the cytoplasm. Name these cells.

6. A patient with suspicion of an allergic condition was made a general blood test. What blood cells can be detected as increased?

7. When introducing a foreign protein to the patient, the activity of eosinophils was noted. What substance do they metabolize?

8. In the patient's leukocyte formula, the percentage of segmented neutrophils is increased and there are no young and stab neutrophils. What is the name of this state of the leukocyte formula?

9. The first half of pregnancy in some women is complicated by toxicosis, which develops in response to the entry of fetal metabolites into the woman's blood. Which blood cells will respond to these toxic foods?

10. The leukocyte formula of a healthy person contains 32% neutrophils and 54% lymphocytes. At what age is this ratio normal?

11. The electron diffraction pattern shows a blood cell (lymphocyte) with a diameter of 6-7 microns. The nuclear-cytoplasmic index is shifted towards the nucleus. Chromatin is paid, the nucleolus is large. The cytoplasm has a high

electron density. It contains a large number of ribosomes. What are these lymphocytes?

12. The electronogram shows a blood cell (lymphocyte) with a diameter of 14 μm. The nucleus is round and contains large lumps of heterochromatin, which are arranged in the form of radial strands. What are these lymphocytes?

13. The role of receptors for antigen on B-lymphocytes is performed by surface immunoglobulins. What class of immunoglobulins does not belong to them:

14. In the study of the patient's immune status, a sharp decrease in the level of immunoglobulins was revealed. What blood cells are impaired with?

15. When analyzing the blood, the laboratory assistant concluded that the blood belongs to the newborn. The structural features of what shaped elements makes it possible to make such a conclusion?

Microslides

1. Human blood smear. Romanovsky-Giemsa staining.

Specimens for study

Specimen for examination 1. Human blood smear (Fig. 1).

Small magnification. With this magnification, numerous erythrocytes are visible, painted in a pale pink color, among which dark-colored nuclei of leukocytes are noticeable. It is necessary to choose a place with well-fixed erythrocytes.

High magnification. Among the erythrocytes, leukocytes are visible - 1-5 in the field of view. The most common are segmented neutrophils, which have a dark purple segmented nucleus and an almost transparent (slightly pink) cytoplasm with very fine granularity that is difficult to distinguish. Eosinophilic granulocytes are distinguished by a pronounced oxyphilia of the cytoplasm with large pink granules of the same size, the nucleus is less dense than in segmented neutrophils, and for the most part has two segments (sometimes three). Basophils are rarely found; they are characterized by the presence of a pale, not always completely segmented nucleus and purple granules of various sizes in the cytoplasm. Lymphocytes have a rounded nucleus and a small rim of the cytoplasm. Chromatin in the nucleus is sharply condensed; on the preparation it has a dark purple color. Small, medium and large lymphocytes differ not only in size, but also in the density of the nuclei. Small ones have condensed chromatin in the nucleus and a narrow rim of the cytoplasm, the middle ones have less condensed chromatin, the rim of the cytoplasm is wider. The

nucleus of a large lymphocyte is even larger and friable, the volume of cytoplasm is also larger.
Monocytes are easier to find at the periphery of the smear. These are large cells with a significant area of cytoplasm of blue color, a large bean-like or irregularly shaped nucleus.
Platelets are small in size (three times smaller than erythrocytes), are located in small groups between cells, and have a faintly purple color.
Draw and Designate: 1) erythrocytes; 2) lymphocytes (small and medium); 3) monocyte; 4) neutrophilic granulocytes; 5) eosinophils; 6) basophilic granulocyte; 7) platelets.

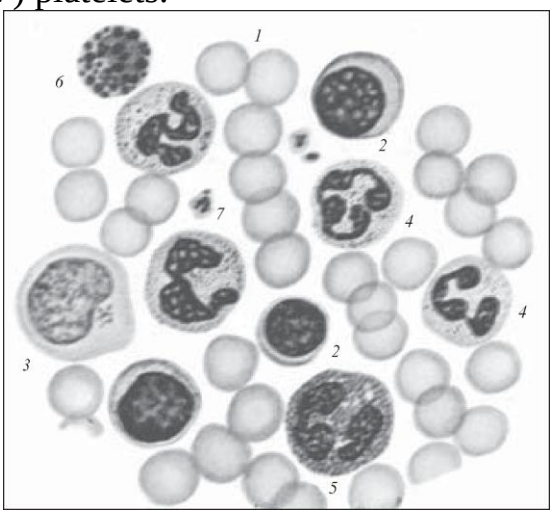

Figure: 1. Human blood smear. Romanovsky-Giemsa staining. × 900:
1 - erythrocytes; 2 - lymphocytes (small, medium); 3 - monocyte; 4 - neutrophilic granulocytes; 5 - eosinophils; 6 - basophilic granulocyte; 7 - platelets

Electron micrographs

1. Neutrophilic granulocyte.

2. Basophilic granulocyte.

Segmented neutrophil

Segmented neutrophilic granulocyte (leukocyte). Electronic microphotogram. × 12 000

1 – lobes of nucleus; 2 – strands between lobes; 3 – specific neutrophilic granules in the cytoplasm; 4 – endoplasmic reticulum; 5 – mitochondria.

Basophilic leukocyte

Basophilic granulocyte (leukocyte). Electronic microphotogram. × 18 000

1 – lobulated nucleus with dense chromatin; 2 – basophilic granules; 3 – glycogen granules.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. When analyzing the patient's blood, the determination of the number of leukocytes and the percentage of their various forms are of great diagnostic value. What is not typical for leukocytes?

A. Are postcellular structures

B. Realize their functions outside the vascular bed

C. Have active mobility

D. Diverse in function

E. Contain nucleus and organelles

2. A number of clinical syndromes associated with severe infectious lesions of the body are caused by impaired mobility of leukocytes. What is irrelevant to the selective migration of leukocytes into tissue?

A. Chemotaxis

V. Reotaxis

C. Contracting activity of the cytoskeleton

D. Pseudopodia

E. Adhesion

3. A patient with a severe inflammatory process was found to have significant leukocytosis: 40x109 / l with severe neutrophillosis. What function is not characteristic of neutrophils?

A. Destroy microorganisms

B. Phagocytose damaged cells and tissues

C. Produce cytokines

D. Synthesize prostacyclins

E. Produce nylons

4. The antimicrobial effect of neutrophils is realized with the help of antibacterial proteins contained in their granules. What protein does neutrophil granules not contain?

A. Lysozyme

B. Lactoferrin

C. BPI protein

D. Phagocytin

E. Serotonin

5. One of the indicators of a person's immune status is the determination of the number of phagocytic cells in the neutrophil population. What is this indicator called?

A. Immune activity

B. Recovery index

C. Mitotic index

D. Phagocytic index

E. Phagocytic activity

6. One of the indicators for determining the immune status of a person is to determine the number of particles absorbed by one phagocytic cell. What is this indicator called?

A. Immune activity

B. Recovery index

C. Mitotic index

D. Phagocytic index

E. Phagocytic activity

7. When conducting a forensic examination of a blood sample in neutrophilic granulocytes, chromatin in the form of a drumstick is visible on the surface of one of the segments of the nucleus. What is the name of such a structural formation?

A. Euchromatin

B. Decondensed chromatin

S. Taurus Lyon

D. Barr's body

E. Taurus Pacini

8. A patient with pneumonia in the general blood test revealed an increase in the number of leukocytes. What is the name of this phenomenon?

A. Leukocytosis

B. Pinocytosis

C. Leukopenia

D. Anisocytosis

E. Poikilocytosis

9. After the end of an attack of bronchial asthma (an immediate allergic reaction), the patient underwent a study of peripheral blood. What changes can be expected on the part of white blood?

A. Erythrocytosis

B. Leukopenia

C. Lymphocytosis

D. Thrombocytopenia

E. Eosinophilia

10. In a smear of peripheral blood among leukocytes, rounded cells with segmented nuclei predominate. The fine granularity in their cytoplasm is stained with both acidic and basic dyes. What are these cells called?

A. Monocytes

B. Basophils

C. Eosinophils

D. Segmented neutrophils

E. Young neutrophils

11. In a conditioned experiment, one of the populations of blood cells was selectively stimulated. As a result, vascular permeability increased significantly, which was manifested by tissue edema. Which blood cells have been stimulated?

A. Basophils

B. Erythrocytes

C. Platelets

D. Eosinophils

E. Lymphocytes

12. In a conditional experiment, basophils were stimulated. As a result, vascular permeability increased significantly, which was manifested by tissue edema. What substance of their granules can change the density of cell contacts of the vascular wall?

A. Heparin

B. Histamine.

S. Serotonin

D. Peroxidase

E. Acid phosphatase

13. A patient suffering from chronic pneumonia has an increase in the number of young and stab neutrophils in a blood smear. What is the name of this state of the leukocyte formula?

A. Shift the formula to the right

B. Shift the formula to the left

C. Neutrocytopenia

D. Neutrophilia

E. Lymphocytosis

14. In a blood smear of a patient after influenza, 16% of rounded basophilic cells measuring 4.5-7 μm, with a rounded nucleus, occupying almost the entire volume of the cytoplasm, were found. What is the condition of the blood characterizes such a number of these cells?

A. Neutrophilia

B. Monocytosis

C. Lymphocytosis

D. Lymphocytopenia

E. Monocytopenia

15. An increase in the number of cells with an irregularly shaped nucleus and large metachromatic granules in the cytoplasm was revealed in a blood smear. What type of blood element are these morphological signs typical for?

A. Bazofilov

V. Neutrofilov

S. Eosinophilov

D. Monocytes

E. Erythrocytes

16. At heterotransplantation of the organ, rejection of the transplant was revealed. What blood cells support this process?

A. T-lymphocytes - suppressors

B. T-helper lymphocytes

C. T-lymphocytes - killers

D. T-lymphocyte-O

E. T-lymphocytes-memory

17. When a protein preparation is administered to a patient, the number of plasma cells increases, which produce specific antibodies to the injected antigen. What blood cells are responsible for the increase in the number of plasma cells?

A. Cell-memory

B. T-killers

C. T-suppressors

D. T-helpers

E. B-lymphocytes

18. A smear of peripheral blood shows a large cell with a weakly basophilic homogeneous cytoplasm and a bean-shaped nucleus. The cell is the largest one visible in the field of view. What kind of cell is it?

A. Plasmacyte

B. Large lymphocyte

C. Monocyte

D. Middle lymphocyte

E. Small lymphocyte

19. In a conditional experiment, one of the populations of blood cells (T-lymphocytes) was stimulated. As a result, the level of immunoglobulins increased significantly. What substances regulate the activity of B-lymphocytes?

A. Histamine

B. Lympholiberins

C. Lymphokines

D. Lymphostatin

E. Acid phosphatase

20. In the experiment, the B-lymphocytes of the blood were marked with a label, after which the animal was injected under the skin with a foreign protein. In which cells outside the vessels will the marks be detected?

A. plasmacytes

B. T-lymphocytes

C. macrophages

D. tissue basophils

E. fibroblasts

21. Circulating blood stem cells (SCC), which enter the blood from the bone marrow, morphologically refer to:

A. Large lymphocytes

B. Average lymphocytes

C. Small lymphocytes

D. Monocytes

E. Granulocytes

22. Examination of a frequently ill child revealed a decrease in humoral immunity. Which of the following cells of the immune system provide it?

A. Plasmacytes

B. Macrophages

C. Immunoblasts

D. T-helpers

E. T-suppressors

23. A 40-year-old patient who suffered from burns underwent a skin grafting operation. However, 10 days after the operation, the processes of transplant rejection began to be observed. Which cells are responsible for this effect?

A. T-suppressors

B. T-helpers

C. B-lymphocytes

D. Plasmacytes

E. T-killers

24. A 45-year-old patient has a decrease in the number of B-lymphocytes. Which group are B-lymphocytes?

A. Short-lived and actively mobile

B. Long-lived and sedentary

C. Short-lived and low-mobility

D. Long-lived and actively mobile

E. Long-lived immobile

25. When examining the child's blood, the following data were obtained: erythrocytes - 6 1012 l, leukocytes - 20 □ 109 l, eosinophils - 45%, lymphocytes - 47%; basophils - 0.2%, eosinophils - 20%. What is the child's age?

A. 4 weeks

B. Newborn

S. 1 year

D. 4 years

E. 10 years

26. A blood smear shows a large round cell with a weakly basophilic cytoplasm that does not contain specific granularity; the nucleus is light bean-shaped. Name this cell.

A. Monocyte

B. Platelet

C. B-lymphocyte

D. T-lymphocyte

E. Reticulocyte

27. As a result of a gene mutation, a population of cancer cells has emerged in the body. What blood cells provide anti-tumor protection?

A. T-helpers

B. T-suppressors

C. T-killers

D. B-lymphocytes

E. Monocytes

28. A foreign protein has been introduced into the human body. Which blood cells will not participate in the immune response?

A. T-helpers

B. T-suppressors

B. B-lymphocytes

D. Monocytes

E. T-killers

29. Electron-microscopy in adults, 4 types of lymphocytes are isolated in the lymphocyte population. Which lymphocytes do not belong to them:

A. Small light

B. Small dark

C. Large

D. Medium

E. Plasmacytes

30. The electronogram shows a blood cell (lymphocyte) with a diameter of 7 microns. The nuclear-cytoplasmic index is shifted towards the nucleus. The light cytoplasm contains a small number of ribosomes and mitochondria, the Golgi complex and EPS are weakly expressed. Identify this lymphocytes.

A. Small light

B. Small dark

C. Large

D. Medium

E. Plasmacyte

7. Materials for methodological support of self-training of students.

Main literature

1. Histology, cytology. embryology. / Ed. Units Lutsyk, Y.B. Tchaikovsky // Pidruchnik.Vinnitsa "New book", - 2018. - 591 p.

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METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

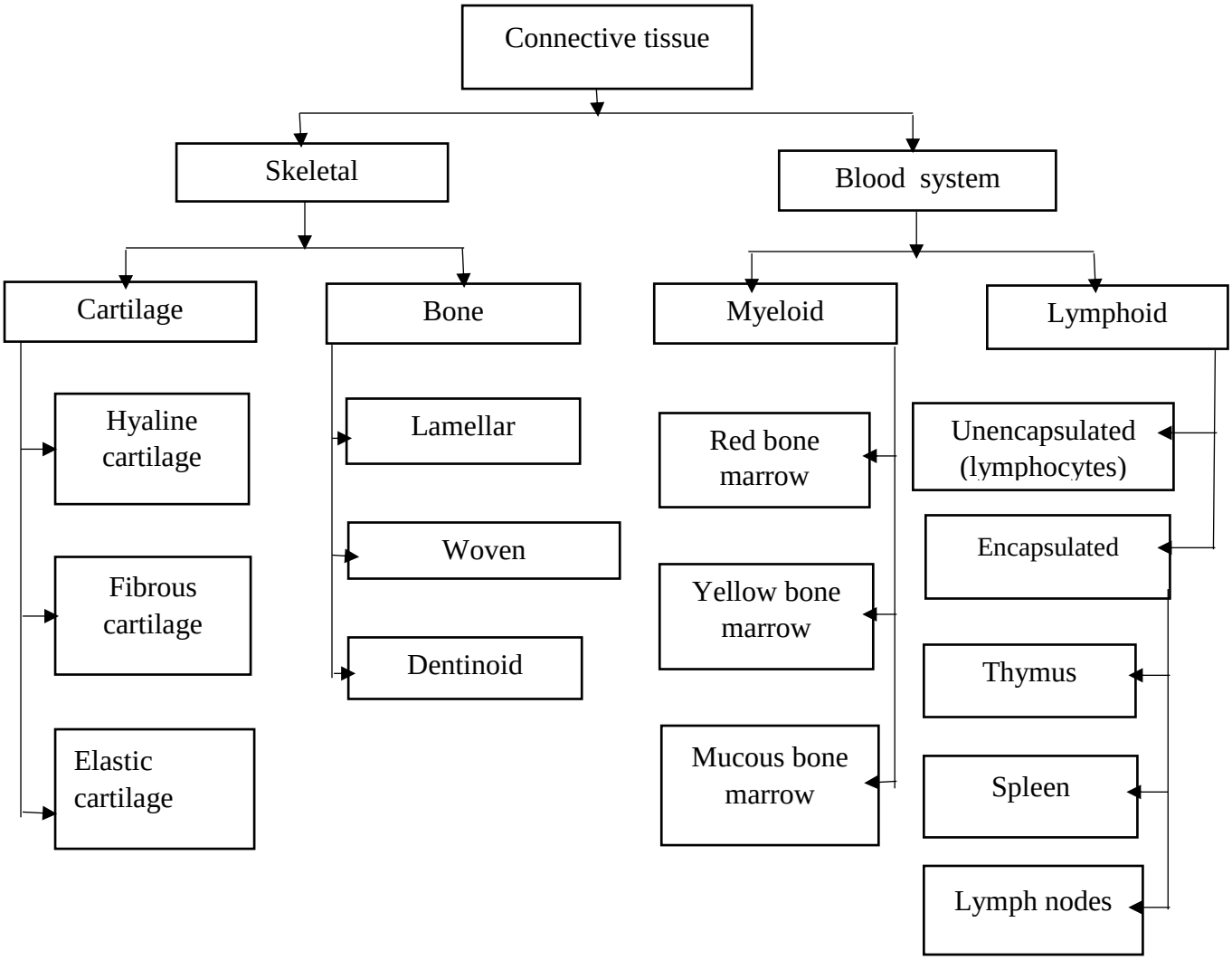
Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

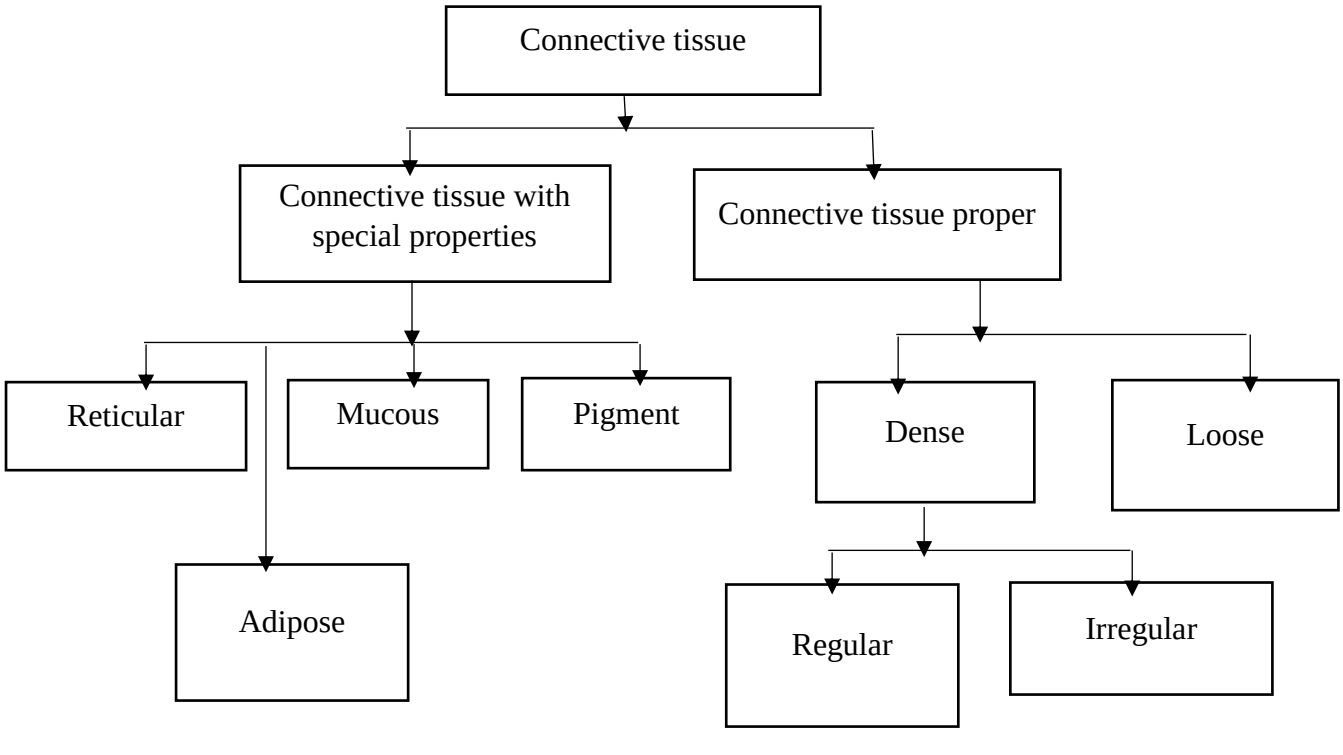
Candidate of medical sciences, senior lecturer. Markova O.O.

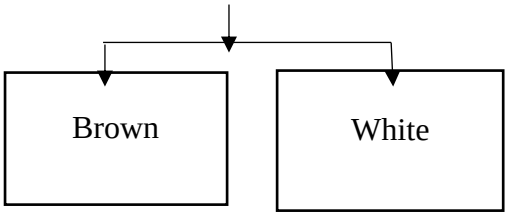
st.excl. Lyashevska O.O.

4. Topic content

Graph logical structure of the lesson







5. Plan and organizational structure of the practical lesson

№ .	The main stages of employment, their functions and content.	Learning objectives in the levels of assimilation.	Training and control methods.	Materials for methodological support of the clarity of the lesson, control of the knowledge of those who are studying.	The term (in minutes or in%) of the total time of the lesson.
1	2	3	4	5	6

I. 1. 2. 3. 4. II 1. 2. III.	Preparatory stage. Organization of the lesson. Designation of educational goals and objectives. Control of the initial level of knowledge, skills and abilities. Readiness to absorb the material of the current lesson. The main stage Formation of students' skills and abilities (survey, interview-poll, testing, written assignments). Consolidation of knowledge and practical work of students with slides. The final stage. Summing up the results of the lesson. Providing homework.	I.Acquaintance II. Know III.Technique of execution IV.Research skills	Projector, TVs, computers. TVs, computers Microscope microscopic preparations, albums	Tables, slides, dummies, scheme, tests. Tables, set of tests, written assignments, situational tasks. Drawings from the atlas, electron diffraction patterns. List of literature, questions, tasks.	5 -15min. 30min 30-35min 5 min

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. Concept and classification of connective tissue.

2. Morphological and functional characteristics of loose fibrous connective tissue.

3. Cellular composition of loose fibrous connective tissue.

4. Functions, structural features and sources of development:

- fibroblasts, fibrocytes, fibroclasts, myofibroblasts,
- macrophages,
- tissue basophils,
- plasmacytes,
- adipocytes,
- pigment cells,
- adventitious cells

Questions for individual work.

1. The concept of the macrophage system of the body.
2. The relationship of cells of loose fibrous connective tissue and blood.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. In loose fibrous connective tissue, cells with short, unstable processes are determined. The cytoplasm contains the pigment melanin. What are these connective tissue cells?

2. Connective tissue is characterized by a variety of cells and a well-developed intercellular substance. What connective tissue cells are of monocytic origin?

3. The activity of fibroblasts is associated with the formation of basic substance and fibers, wound healing, the development of scar tissue, the formation of a connective tissue capsule around a foreign body, etc. What substances are synthesized by these cells?

4. Scar tissue formed at the site of the surgery. Which connective tissue cells were involved in this process?

5. In the experiment, a foreign body was introduced into the tissue. Over time, a connective tissue capsule formed around it. Which connective tissue cells were involved in this process?

6. The body has a bacterial infection. Which connective tissue cells will participate in cellular immunity?

7. Most cells of loose fibrous connective tissue are of mesenchymal origin. However, there are nets related to this fabric, as they are located in it. Their formation has been proven from neural crests, and not from the mesenchyme. What kind of cells are they?

8. The connective tissue is characterized by a variety of cells that perform important functions and are highly specialized. What connective tissue cells are referred to as molar specialized?

9. The leading role in the vascular phase of inflammation is played by histamine. Which connective tissue cell produces histamine?

10. The patient developed an allergic reaction in the form of urticaria (blisters formed under the epidermis due to the release of plasma into the loose connective tissue). What substance produced by mast cells causes an increase in the permeability of the vascular wall?

11. After a hand injury, the woman had bleeding, which was accompanied by weak blood coagulation (with a normal number of platelets in the blood test). What substance of loose connective tissue prevents blood clotting?

12. Histamine plays an important role in the development of clinical manifestations of allergy. What cells produce it?

13. A small amount of specific antibodies was detected in the blood of a patient with a viral infection. Which connective tissue cells have decreased function?

14. On a histological section of the mammary gland, large cells filled with basophilic metachromatic granularity were identified in the connective tissue. Histochemical examination revealed that the granules contain heparin and histamine. What kind of cells are they?

15. During surgical intervention on the vessels, there is a risk of blood clot formation. What connective tissue cells prevent thrombosis?

16. When examining a histological preparation, neutrophils are determined in the connective tissue. What is the function of these cells, penetrating from the blood into the tissue?

17. A foreign body has penetrated into the skin, causing inflammation. Which connective tissue cells are involved in the reaction of the skin to a foreign body?

Micropreparations

1. Loose fibrous unformed connective tissue. Film preparation. Iron hematoxylin staining.

Specimens for study

Specimen for examination 1. Loose fibrous irregular connective tissue. Film preparation (Fig. 1).

Small magnification. Find the most transparent area of the slide.

High magnification. Cells and fibers are clearly visible against the background of a transparent amorphous substance. It is necessary to find fibroblasts characterized by an elliptic shape, expressionless contours and a light oval nucleus. Macrophages are distinguished by smaller and darker rounded nuclei, darker vacuolated by cytoplasm with a clearly defined irregular contour. Plasmacytes are round in shape, the nucleus is located eccentrically, contains condensed chromatin, a colored area of the cytoplasm is located next to the nucleus (the so-called courtyard, or sphere).

It is necessary to draw each cell separately.

Designate: 1) fibroblast and in it: a) processes; b) the nucleus; 2) macrophage and in it: a) vacuoles; b) the core; 3) plasma cells and in it: a) the nucleus; b) chromatin; c) "courtyard".

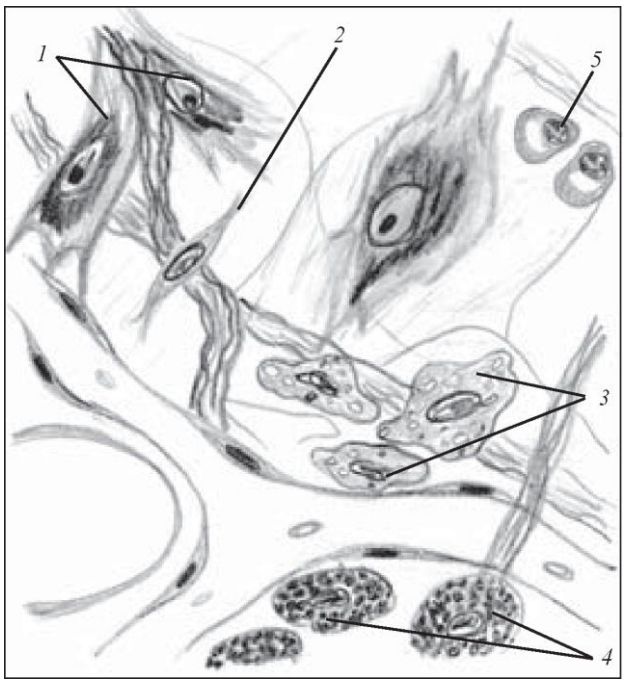


Figure: 1. Loose fibrous irregular connective tissue. Film preparation. Iron hematoxylin staining. × 600:
1 - fibroblasts; 2 - fibrocytes; 3 - macrophages; 4 - mast cells; 5 - plasma cells

Electron micrographs

1. Fibroblast

2. Fibroblast shkiri

3. Macrophage.

4. Adipocyte of brown adipose tissue

5. Plasmacyte.

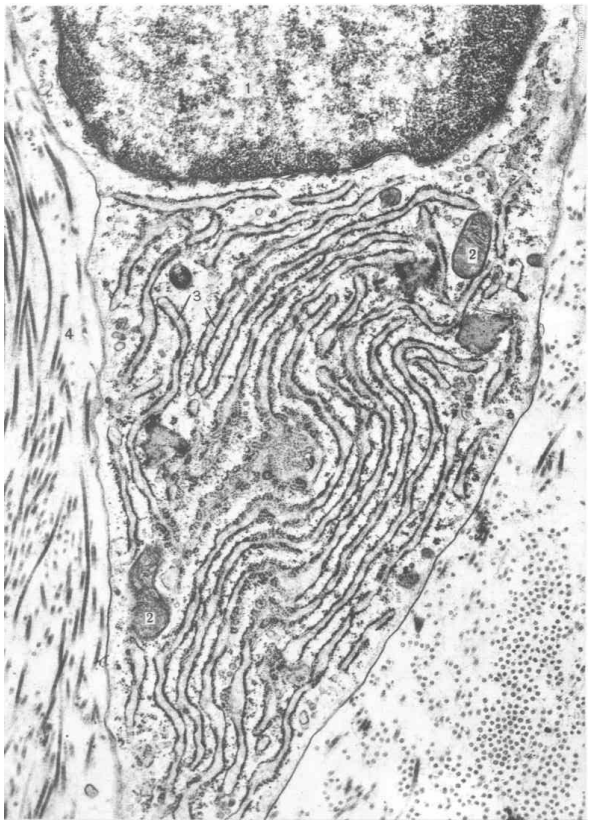
Fibroblast of the nuchal ligament

Fibroblast from the nuchal ligament from a 6 month old human fetus.
Electronogram. × 18 000

1 - nucleus; 2 – Golgi complex; 3 – rough endoplasmic reticulum; 4 - mitochondria; 5 – disordered protofibrils; 6 – protofibrils that are oriented on the cell surface; 7 – collagen fibrils; 8 – elastin fibrils.

Fibroblast from the wound

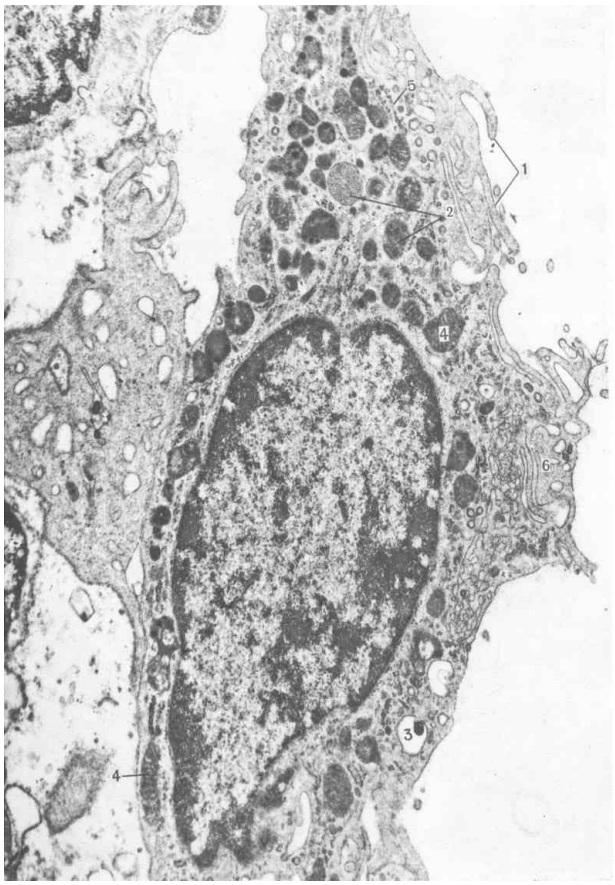
Fibroblast. Electronic microphotogram from the wound of a guinea pig skin. × 18 000



1 – nucleus of fibroblast; 2 - mitochondria; 3 – endoplasmic reticulum; 4 – collagen fibers.

Macrophage

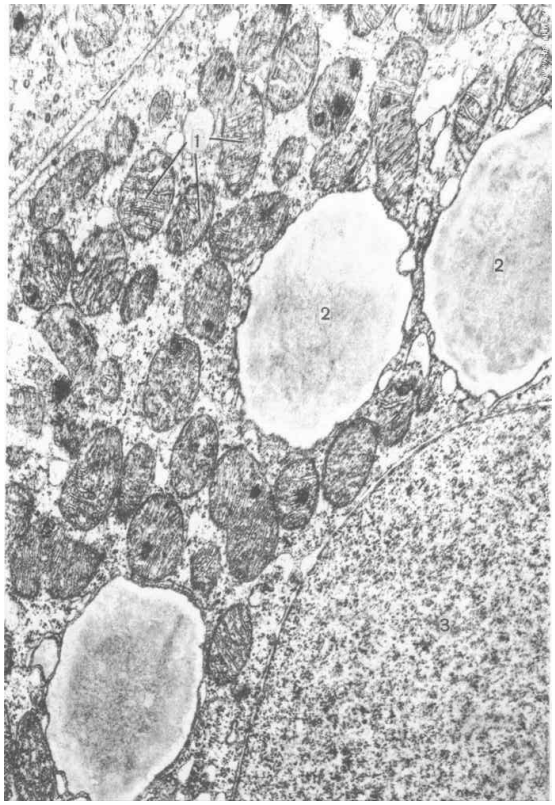
Macrophage. Electronic microphotogram of macrophage from the lymphatic follicle. × 13 000



1 - pseudopodia; 2 – lysosomes with a fine-grained component; 3 – digestive vacuoles; 4 - mitochondria; 5 – endoplasmic reticulum; 6 – Golgi apparatus.

Adipocyte of brown adipose tissue

Cell of the brown adipose tissue of a newborn rat. Electronic microphotogram. × 23 000



1 - mitochondrion; 2 – lipid inclusions; 3 – nucleus.

Plasma cell

Plasma cell. Electronic microphotogram of plasma cell from the spleen of a white rat. × 30 000.

1 - nucleus; 2 – endoplasmic reticulum with a large number of ribosomes; 3 - mitochondria; 4 – perinuclear zone.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. The electron micrograph shows a small-process cell with dispersed nuclear chromatin, a large number of ribosomes and a polysome in the cytoplasm, the rest of the facets are relatively poorly developed. What kind of fibroblast is shown in the micrograph?

A. Specialized

B. Unspecialized

C. Fibrocyte

D. Myofibroblast

E. Fibroclast

2. An electron micrograph shows a cell. The nucleus is light, oval, contains 1-2 large nucleoli. The Golgi complex and granular EPS, which are in contact with the cytolemma, are well developed. Mitochondria and lysosomes are moderately developed. Microfilaments are located along the periphery. What kind of fibroblast is shown in the micrograph?

A. Specialized fibroblast

B. Low-specialized fibroblast

C. Fibrocyte

D. Myofibroblast

E. Fibroclast

3. The electron micrograph shows a spindle-shaped cell with pterygoid processes with compact nuclear chromatin. The cytoplasm contains a small amount of organelles, vacuoles, lipids and glycogen. What kind of fibroblast is shown on the micrograph

A. Specialized

B. Unspecialized

C. Fibrocyte

D. Myofibroblast

E. Fibroclast

4. In the histological specimen of the uterine wall during the development of pregnancy, cells were found that are functionally similar to smooth muscle cells, but, unlike the latter, have a well-developed granular EPS. What kind of cells are they?

A. Specialized fibroblast

B. Low-specialized fibroblast

C. Fibrocyte

D. Myofibroblast

E. Fibroclast

5. In the uterus after the end of pregnancy, cells with high phagocytic and hydrolytic activity are found in the connective tissue, taking part in the "resorption" of the intercellular substance. The cytoplasm of these cells contains a large number of lysosomes. What kind of cells are they?

A. Specialized fibroblast

B. Low-specialized fibroblast

C. Fibrocyte

D. Myofibroblast

E. Fibroclast

6. The electron micrograph shows a cell of irregular shape, the cytolemma forms folds and long micro outgrowths. The nucleus is small, rounded, with large lumps of chromatin. The cytoplasm is rich in lysosomes, phagosomes and pinocytic vesicles, contains a moderate amount of mitochondria, granular EPS, Golgi complex, inclusions. Which connective tissue cell is shown in the micrograph?

A. Differentiated fibroblast

B. Adipocyte

C. Macrophage

D. Tissue basophil

E. Plasmacyte

7. As a result of radiation, stem hematopoietic cells are damaged. Which connective tissue cells will be impaired?

A. Differentiated fibroblast

B. Adipocyte

C. Pigmentocyte

D. Tissue basophil

E. Fibroclast

8. Pyrogen is involved in the increase in body temperature in inflammatory diseases. Which connective tissue cells synthesize this biologically active factor?

A. Differentiated fibroblast

B. Adipocyte

C. Macrophage

D. Tissue basophil

E. Plasmacyte

9. In the inflammatory process actively phagocytic cells, rich in organelles for intracellular digestion of absorbed material and synthesizing antibacterial substances, participate. Which connective tissue cells perform these functions?

A. Fibroblast

B. Adipocyte

C. Macrophage

D. Tissue basophil

E. Plasmacyte

10. Cells of connective tissue are able to absorb antigens, convert them from corpuscular to molecular form. Coming into contact with immunocompetent cells, these cells transmit the information necessary for the formation of antibodies. What are these connective tissue cells?

A. Fibroblast

B. Adipocyte

C. Macrophage,

D. Tissue basophil

E. Plasmacyte

11. A preparation of loose connective tissue is stained with a special dye that detects acid phosphatase. Some of the cells in this preparation demonstrate high activity of this enzyme. What kind of cells are they?

A. Fibroblasts

B. Adipocytes

C. Macrophages

D. Tissue basophil

E. Plasmacytes

12. In the loose fibrous connective tissue of the omentum, cells of a rounded shape were found, the cytoplasm was sharply basophilic. The core is oval, eccentrically located. There is a small light zone near the nucleus. What are these connective tissue cells?

A. Fibroblasts

B. Adipocytes

C. Macrophages

D. Tissue basophil

E. Plasmacytes

13. The electron micrograph shows an oval cell. The nucleus is relatively small, rounded, eccentrically located; granular EPS, Golgi complex, and many ribosomes are well developed in the cytoplasm. What kind of connective tissue cell is it?

A. Fibroblast

B. Adipocyte

C. Pigmentocyte

D. Tissue basophil

E. Plasmacyte

14. When an antigen enters the human body, antibodies are actively produced, providing humoral immunity. Which connective tissue cells are directly involved in this process?

A. Fibroblasts

B. Adipocytes

C. Macrophages

D. Tissue basophils

E. Plasmacytes

15. On a histological specimen stained with hematoxylin-eosin, cricoid-shaped cells are determined. The entire central part of the cells is not stained and is surrounded by a thin rim of pink cytoplasm. The nucleus is flattened, shifted to the periphery. What kind of connective tissue cell is it?

A. Fibroblast

B. Plasmacyte

C. Pigmentocyte

D. Adipocyte

E. Tissue basophil

16. A histological specimen of connective tissue was stained with a special dye - Sudan III. Some of the cells turned orange. Which cells of connective tissue can be used to detect?

A. Fibroblasts

V. Macrophagov

C. Pigmentocytes

D. Tissue basophils

E. Adipocytes

17. Cells of loose fibrous connective tissue involved in trophism, energy production and water metabolism. These cells are located in groups, less often singly, and, as a rule, near the blood vessels. What are these connective tissue cells?

A. Fibroblasts

B. Adipocytes

C. Macrophages

D. Tissue basophils

E. Plasmacytes

18. On a histological specimen of tonsils, cells of a rounded shape are determined. Nucleus with densely located chromatin. In the cytoplasm there are numerous granules of different density and composition, organelles are poorly developed. What are these connective tissue cells?

A. Fibroblasts

B. Adipocytes

C. Macrophages

D. Tissue basophils

E. Plasmacytes

19. At the site of the wasp sting, there is a burning sensation, hyperemia, edema. As a result of an allergic reaction, the permeability of the vascular wall increases, the luminosity of the blood and the permeability of the intercellular substance decrease. Which connective tissue cells are involved in these processes?

A. Fibroblasts

B. Adipocytes

C. Tissue basophils

D. Macrophages

E. Plasmacytes

20. A large number of granules can be seen on the histological specimen next to the mast cells. In the process of degranulation, there was a partial violation of the integrity of the cell membrane and granules. What substance does the granules contain?

A. Serotonin

V. Heparin

S. Pirogen

D. Interferon

E. Lysotsin

7. Materials for methodological support of self-training of students.

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METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1.Comparative characteristics of dense connective tissue and

loose connective tissue.

2. What are the varieties of dense connective tissue and give

them a brief description.

3. The structure of the intercellular substance and the characteristics of its main components.

4. Describe the levels of collagen fiber organization.

5. Name the main types of collagen and their localization in the body.

6. Describe the levels of elastic fiber organization.

7. Describe the structure, function and localization of the tendon.

8.Explain the structural and functional differences between white and

brown adipose tissue.

9.Localization and morphofunctional characteristics of the reticular connective tissue.

10. Describe the structure, function and localization of the pigmented connective tissue.

11. Describe the structure, function and localization of the connective tissue mucosa.

Questions for individual work.

1. Unformed dense connective tissue, structure, function.

2. Levels of elastic fiber organization.

3. Reticular tissue: localization, structural features, functions.

4. Pigment tissue: localization, structural features, functions.

5. Comparative structural and functional characteristics of white and brown adipose tissue.

6. Mucous tissue: localization, structural features, functions.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. A histological specimen of connective tissue stained with a special dye for fat is presented. Adipocytes are visible, in the cytoplasm of which there are numerous small drops of fat, a spherical nucleus lies in the center of the cell. What kind of tissue is shown on the preparation?

2. A histological specimen of connective tissue stained with a special dye for fat is presented. Adipocytes are visible, in the cytoplasm of which there is one large drop of fat, the nucleus is flattened, lies on the periphery of the cell. What kind of tissue is shown on the preparation?

3. A histological specimen of a hematopoietic organ is presented, the stroma of which is represented by fibers and cells associated with them, star-shaped, interconnected by processes. What kind of tissue is shown on the preparation?

4. The histological specimen presents connective tissue, the cellular elements of which are represented by mucocytes. Hyaluronic acid is found in large quantities between the cells. Where is this tissue localized?

5. A histological specimen of the umbilical cord is presented, in which pale-staining cells of a processional form - fibroblasts and a transparent homogeneous intercellular substance between them are determined. What kind of tissue is shown on the preparation?

6. There are given preparations of mucous connective tissue from two human fetuses. What sign should you pay attention to in order to determine which of the fruits was older?

7. The structure of collage fiber is determined by fibrillar protein - collagen, which is synthesized by fibroblasts. At what level of collagen fiber organization are protofibrils formed?

8. The structure of collage fiber is determined by a fibrillar protein - collagen, which is synthesized by fibroblasts. At what level of organization of collagen fiber do fibrils represent cross-striated structures with an average thickness of 20-100 nm?

9. The structure of collage fiber is determined by a fibrillar protein - collagen, which is synthesized by fibroblasts. To what level of collagen fiber organization does procollagen belong?

10. A patient consulted a doctor about an increase in the size of a birthmark on the skin of the shoulder. What connective tissue underlies this formation?

11. The intercellular substance of the connective tissue consists of fibers and the main component. The main substance includes glycosaminoglycans, proteoglycans and glycoproteins. What does not apply to glycosaminoglycans?

12. Glycoproteins, which are part of the amorphous component, bind cells with the extracellular matrix. What does not apply to them?

Microslides

1. Fibers of connective tissue. Stained with resorcinol-fuchsin.

2. Tendon in longitudinal section. Hematoxylin-eosin staining

3. Reticular tissue of the lymph node. Hematoxylin-eosin staining.

4. White adipose tissue of the omentum. Coloring Sudan – 3

Specimens for study

Specimen for examination 1. Connective tissue fibers (Fig. 1).

Small magnification. Find the most transparent area of the specimen.

High magnification. Against the background of a transparent amorphous substance, one can see thick, slightly sinuous, pink collagen fibers and thin, branched, elastic ones - purple in color.

Draw and designate: 1 - collagen fibers; 2 - elastic fiber.

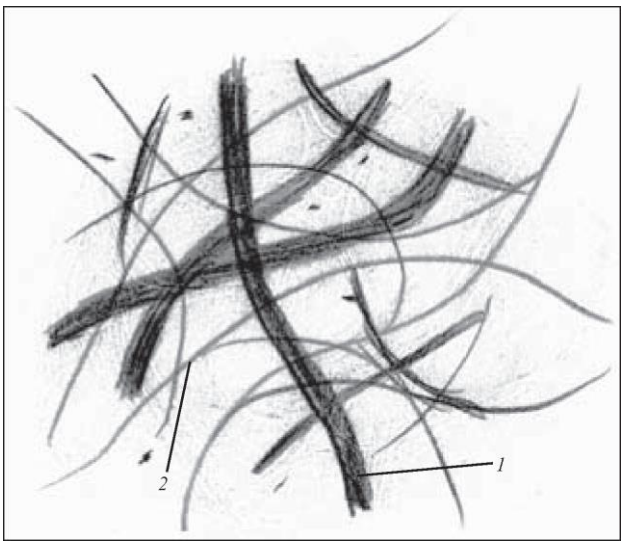


Figure: 1. Collagen and elastic fibers of loose fibrous connective tissue. Stained with resorcinol-fuchsin. × 400:
1 - collagen fibers; 2 - elastic fiber

Specimen for examination 2. Dense regular fibrous connective tissue. Tendon in longitudinal section (Fig. 2).

Small magnification. With such an increase, tendon bundles are clearly visible, separated by layers of loose loose connective tissue - endothenonia, which is characterized by a large number of connective tissue cell nuclei. The cytoplasm is poorly visible.

High magnification. Collagen fibers are colored pink with eosin, are located parallel to each other (first order bundles). The nuclei of fibrocytes are located along them. Endotenonium combines several beams of the first order into beams of the second order. Peritenonium - a layer of loose fibrous connective tissue around a group of collagen fibers - bundles of the III order, vessels longitudinally or transversely cut, which are part of the loose connective tissue.

Sketch the preparation. In the figure, designate: 1) bundles of collagen fibers of the first order; 2) fibrocytes; 3) bundles of collagen fibers of the II order; 4) endotenonium.

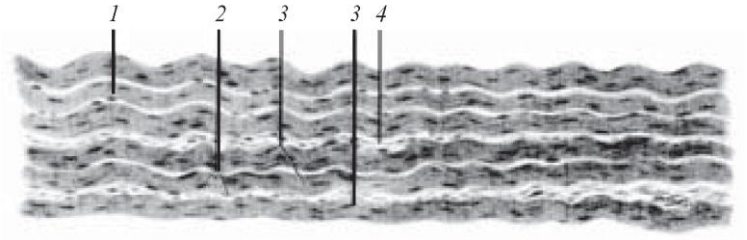


Figure: 2. Dense regular fibrous connective tissue. Tendons in a longitudinal section. Hematoxylin-eosin staining. × 80:
1 - bundles of collagen fibers of the first order; 2 - fibrocytes; 3 - bundles of collagen fibers of the II order; 4 - endotenonium

Specimen for examination 3. Reticular tissue of the lymph node (Fig. 3).

Small magnification. Find the most transparent area in the center of the preparation, in which the cells of an elliptical shape with a large, weakly stained nucleus and pale pink cytoplasm are very clearly visible. Among them are cells with a rounded dense purple nucleus and a narrow rim of basophilic cytoplasm (lymphocytes).
Great magnification. Consider the details of the structure of individual structures and draw them.
Draw and designate: 1) reticular cells: a - nuclei; b - cytoplasm; 2) macrophage; 3) lymphocytes; 4) trabecula of the lymph node.

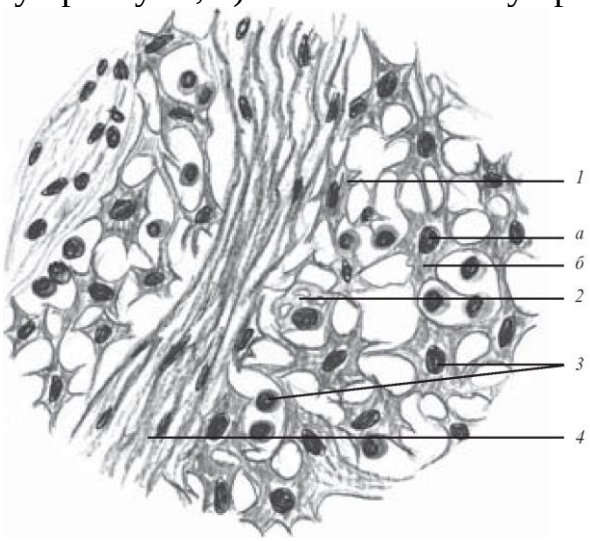


Figure: 3. Reticular tissue of the lymph node. Hematoxylin-eosin staining. × 900:
1 - reticular cells (a - nuclei, b - cytoplasm) 2 - macrophage; 3 - lymphocyte; 4 - trabeculae of the lymph node.

Specimen for examination 4. Adipose tissue of human (Fig. 4).
Small magnification. Find clusters of fat cells located along the blood vessels, look like strands.
High magnification. Consider the structure of single-droplet fat cells. Almost the entire cell is not stained, since it is filled with a drop of fat, which requires a special dye to be detected. Painted in a pale pink color, the cytoplasm forms a thin rim along the periphery, in which a thickened pale blue nucleus is located. Draw and designate: 1) fat cells: a - cytoplasm; b - core; c - the place of the former drop of fat, dissolved with alcohol 2) blood vessels; 3) fibrous connective tissue.

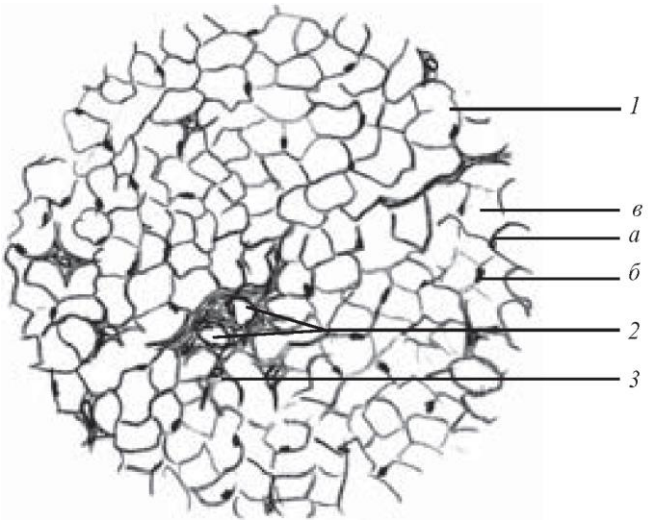
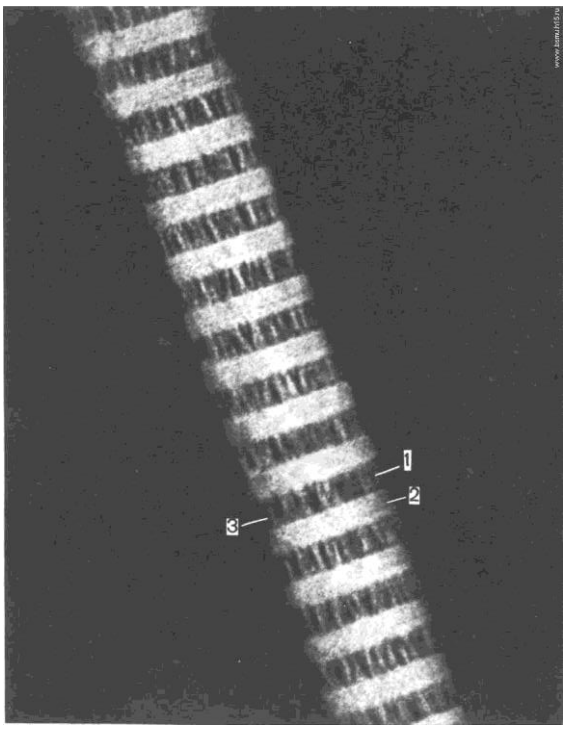


Figure: 4. Adipose tissue. Hematoxylin-eosin staining. × 160:
1 - fat cells (a - cytoplasm, b - nucleus; c-place of the former drop of fat, dissolved with alcohol) 2 - blood vessels; 3 - fibrous connective tissue

Electron microphotogram

Collagen fiber

Collagen fibrils. Electronic microphotogram of collagen fibrill from rat tendon. Phosphotungstic acid negative staining at pH 7,4. × 160 000



1 – dark band; 2 – light band; 3 - tropocollagen (collagen protofibrils).

6.3. Control materials for the final stage of the lesson.

Test tasks

1. During training, the athlete's leg was injured. A traumatologist diagnosed a tendon rupture. With a violation of the integrity of what kind of connective tissue is this condition associated?

A. Loose fibrous connective tissue

B. Dense unformed fibrous tissue

C. Dense decorated fibrous tissue

D. Reticular tissue

E. Cartilage tissue

2. With age, human skin changes, which may be manifested by a decrease in its elasticity. What elements of the connective tissue ensure its high elasticity?

A. Elastic fibers

B. Base substance

C. Collagen fibers

D. Cells

E. Reticular fibers

3. On the histological specimen the connective tissue consists of collagen fibers located in parallel, delimited by fibroblasts. This type of connective tissue is called:

A. Loose fibrous

B. Dense decorated

C. Reticular

D. Dense loose

E. Mucous

4. Each mrolecule contains a set of different amino acids. Which amino acid is the second in this set?

A. Glycine or Lysine

B. Proline or desmosin

C. Glinin or lysine

D. Isodesmosine or proline

E. Proline or lysine

5. Experimental animals were injected with a substance that disrupts the formation of collagen fibers. How will this affect the properties of the tendon?

A. Tensile strength will decrease

B. Will not change

C. Reduced elasticity

D. Elasticity will increase

E. Strength will increase

6. The structure of collage fiber is determined by fibrillar protein - collagen, which is synthesized by fibroblasts. At what level of organization is collagen fiber formed by aggregation of fibrils and has a

thickness of 1-10 microns (depending on topography)?

A. Molecular

B. Extracellular

C. Supramolecular

D. Fibrillar

E. Fiber

7. In an infected patient under the influence of bacteria, there is an increase in the tissues of hyaluronidase. How does this affect the permeability of the basic substance of the fibrous connective tissue?

A. Will decrease

B. Does not affect

C. Increase

D. Decreased metabolic processes

E. The composition of glycosaminoglycans decreases

8. There are 12 types of collagen, differing in molecular organization, organ and tissue affiliation. Where is type I collagen found?

A. In the bones, cornea of the eye

B. In the vitreous

C. In the lens capsule

D. In the dermis of the fetal skin

E. Around smooth muscle cells

9. There are 12 types of collagen, differing in molecular organization, organ and tissue affiliation. Where is type II collagen found?

A. In the cornea of the eye

B. In the vitreous

C. In the lens capsule

D. In the dermis of the fetal skin

E. In the form of an exocytoskeleton

10. There are 12 types of collagen, differing in molecular organization, organ and tissue affiliation. Where is type III collagen found?

A. In bones

B. In hyaline and fibrous cartilage

C. In the basement membranes

D. In reticular fibers

E. Around smooth muscle cells.

11. Each procollagen chain contains a set of three different amino acids, which are repeatedly and regularly repeated throughout its length. What amino acids are marker for mature collagen?

A. Hydroxyproline and hydroxylysine

B. Proline and lysine

C. Desmozin and Isodesmozin

D. Lysine and glycine

E. Proline and hydroxylysine

12. The presence of elastic fibers in the connective tissue determines its elasticity and extensibility. What amino acid derivatives impart these properties to elastic fibers?

A. Hydroxyproline and hydroxylysine,

B. Proline and lysine

C. Desmozin and Isodesmozin

D. Lysine and Glycine,

E. Proline and hydroxylysine

13. The histological specimen shows fibers that include type III collagen protein, an increased amount of carbohydrates, and they are able to form a three-dimensional network. What are these fibers?

A. Reticular

B. Elastic

C. Muscular

D. Colagenaceae

E. Nervous

14. In the amorphous component of the intercellular substance of the connective tissue, an increased activity of hyaluronidase is determined. Which function will be performed first?

A. Protective

B. Mechanical

C. Support

D. Transport

E. Form-forming

12. The presence of elastic fibers in the connective tissue determines its elasticity and extensibility. What amino acid derivatives impart these properties to elastic fibers?

A. Hydroxyproline and hydroxylysine,

B. Proline and lysine

C. Desmozin and Isodesmozin

D. Lysine and glycine,

E. Proline and hydroxylysine

16. At electron microscopy of connective tissue, cross-striated fibrils (fibers) with a thickness of 50-100 nm are determined, the repetition period of dark and light areas is 64 nm. What are these structures?

A. Muscle fibers

B. Elastic fibers

C. Elaunin fibers

D. Reticular fibers

E. Collagen fibers

17. A type of dense fibrous connective tissue are fibrous membranes. These do not include:

A. Fascia

B. Outer ligament

C. Aponeuroses

D. Dura mater

E. Perichondrium and periosteum

18. A histological specimen presents connective tissue, consisting of thick, parallel dense bundles of collagen fibers and a small amount of intercellular substance and fibroblasts. What kind of fabric is this?

A. Tendon

B. Fascia

S. Aponeurosis

D. Periosteum

E. Perichondrium

19. A histological specimen shows connective tissue characterized by a disordered arrangement of thick bundles of collagen fibers, an insignificant number of cells and a basic amorphous substance. What is this fabric?

A. Tendon

B. Dura mater

S. Sclera

D. Bundle

E. Dermis of the skin

20. On the preparation of a smear of human red bone marrow, among the cells of the myeloid series and adipocytes, there are cells of a stellate shape, with a weakly oxyphilic cytoplasm, which anastomose with their processes. What kind of cells are they?

A. Macrophages

B. Fibroblasts

C. Reticulatory

D. Osteocytes

E. Chondrocytes

7. Materials for methodological support of self-training of students.

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Additional literature

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METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Test questions

1. Morphofunctional characteristics of cartilage tissue.

2. Histogenesis of cartilage tissue.

3. Describe the differention of cartilage cells.

4. Structure, function and localization of chondroblasts.

5. Describe the morphological and functional characteristics and classification of chondrocytes.

6. The structure of the intercellular substance of the cartilage tissue.

7. The structure and functional significance of the perichondrium.

8. Types of cartilage growth.

9. Classification of cartilage tissue.

10. Localization and structure of hyaline cartilage.

11. Localization and structure of elastic cartilage.

12. Localization and structure of fibrous cartilage.

Questions for individual work.

1. Growth of cartilage.

2. Regeneration of cartilage tissue.

3. Age-related changes in cartilage tissue.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. In the experiment, chondrocytes were destroyed in the embryo at the stage of glycosaminoglycan synthesis. Indicate which stage of chondrogistogenesis will suffer in this case.

2. It is known that the cartilage does not have its own vessels and it receives nutrition diffusely from the vessels of the perichondrium due to the high hydrophilicity of the intercellular substance. What substances provide this property of cartilage?

3. Three zones are identified on a histological specimen of one of the cartilages. In the surface zone there are flattened chondrocytes, in the intermediate zone, the cells are larger, rounded, and in the deep (basal) zone, non-calcified and calcium-based layers are determined. Determine the location of this cartilage.

4. The athlete's articular surface of the cartilage was damaged as a result of a shallow trauma. Name a possible source of regeneration in this area.

5. In elderly people, due to malnutrition of the cartilage, its calcification occurs. Indicate the organ in which calcification does not occur.

Microslides

1. Hyaline cartilage. Hematoxylin-eosin staining.

2. Plastic cartilage. Stained with resorcinol-fuchsin.

3. Fibrous cartilage between the vertebral disc. Hematoxylin-eosin staining

Specimen for examination 1. Hyaline cartilage (Fig. 1).
Small magnification. Find the perichondrium. It surrounds the cartilaginous plate on all sides. In the perichondrium, you can see a fibrous layer with blood vessels, under which chondroblasts are located in the chondrogenic layer. The perichondrium contains hyaline cartilage tissue, which consists of individual cells, isogenic groups and intercellular substance, painted in pink-purple color.
High magnification. Find young flattened chondrocytes that are located under the perichondrium. Mature oval cartilage cells are placed deeper. Isogenic groups of cartilage cells (2-4) lie in one capsule in the intercellular substance. Around isogenic cells, the intercellular substance is basophilic colored in violet - this is the territorial matrix of cells, and the interterritorial matrix is weakly basophilic (pale violet). Draw and designate: 1) perichondrium: a) young cartilaginous cells; b) intercellular substance; c) cartilage cells; d) a cartilage cell capsule; e) cellular; f) isogenic group of cartilage cells.

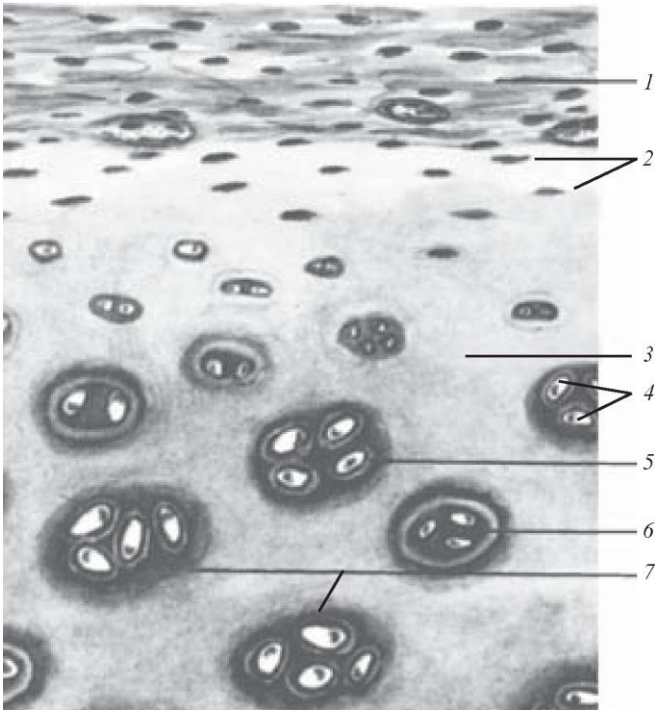

Figure: 1. Hyaline cartilage. Hematoxylin-eosin staining. × 400: 1 - perichondrium; 2 - young cartilage cells; 3 - intercellular substance; 4 - cartilage cells; 5 - cartilage cell capsule; 6 - cellular territories; 7 - isogenic group of cartilage cells

Specimen for examination 2. Elastic cartilage of the auricle (Fig. 2).
Small magnification. It can be seen that the general plan of the structure is similar to that of hyaline cartilage.
High magnification. The limits of isogenic cell groups are clearly visible. Elastic fibers are selectively dyed in blue-blue, are arranged in different directions.
Draw and designate: 1) ocher: a) ground substance; b) elastic fibers; c) cartilage cell; d) cartilage capsule; e) an isogenic group of cartilage cells.

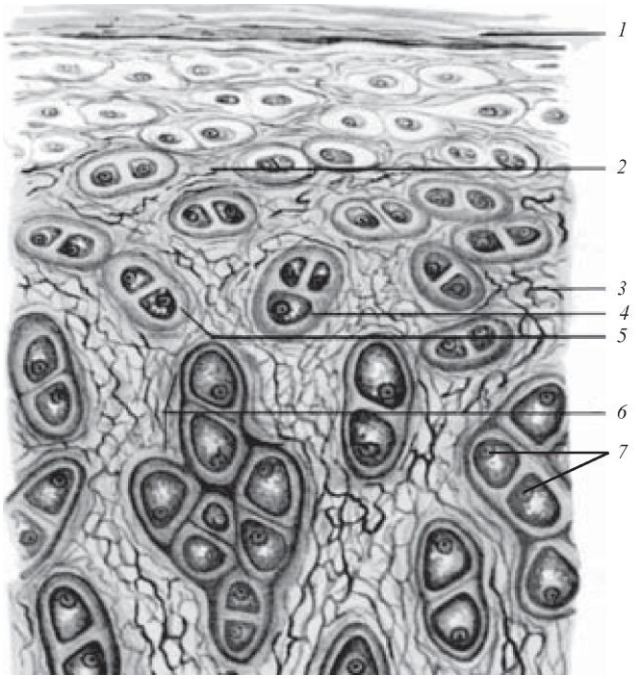

Figure: 2. Elastic cartilage of the auricle. Resorcinfuchsin staining. × 400:
1 - perichondrium: 2 - basic substance; 3 - elastic fibers; 4 - cartilaginous cell; 5 - cartilaginous capsule; 6 - isogenic group of cartilage cells; 7 - the nucleus of the cartilaginous cell

Specimen for examination 3. Fibrous cartilage (Fig. 3).
Small magnification. An area of hyaline and fibrous cartilage is visible on the specimen.
High magnification. The bundles of collagen fibers have a somewhat oblique direction and are colored pink. Chondrocytes are elongated, arranged in columns (chains) between the fibers. Sketch the preparation.
In the figure, designate: 1) hyaline cartilage tissue; 2) collagen-fibrous cartilage tissue; 3) chondrocytes; 4) intercellular substance.

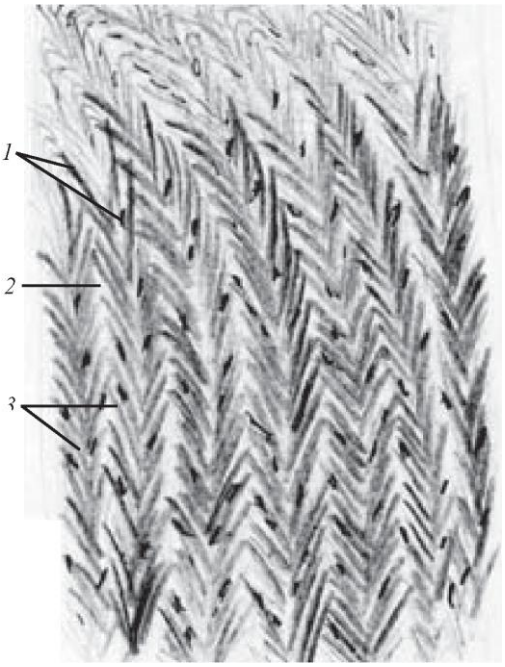

Figure: 3 Fibrous cartilage. Hematoxylin-eosin staining. × 80:
1 - chondrocytes; 2 - intercellular substance; 3- collagen fibers

6.3. Control materials for the final stage of the lesson.

Test tasks

1. It is known that chondrocytes of I, II and III types are the main types of cells in cartilage tissue. Specify the distinctive feature of type I chondrocytes.

A. High nuclear-cytoplasmic index

B. Low nuclear-cytoplasmic index

C. Orderly arrangement of granular EPS

E. A large number of elements of smooth EPS

D. High level of synthetic processes

2. A histological preparation of cartilaginous tissue is presented, in which fibers that do not have an ordered orientation are determined by staining with orsein. Which organ is being examined?

A. Auricle

B. Intervertebral discs

C. Articular surfaces

D. Epiglottis

E. Metaepiphyseal plate

3. An electron micrograph of the cartilaginous tissue shows a cell in which the granular endoplasmic reticulum is well developed and well-ordered, with a low Hertwig index. Name this cell.

A. Chondrocyte III type

B. Chondrocyte P type

C. Chondrocyte type I

D. Chondroblast

E. Prechondroblast

4. In the preparation of cartilage tissue in the composition of isogenic groups, histochemical studies have revealed cells with high protein synthesis and reduced synthesis of glycosaminoglycans. Name these cells.

A. Chondrocytes III type

B. Type II chondrocytes

C. Chondrocytes type I

D. Chondroblasts

E. Prechondroblasts

5. A histological specimen of developing embryonic cartilage is presented, where the perichondrium is formed along the periphery of the cartilaginous anlage, on the border with the mesenchyme. For what stage of histogenesis is this characteristic?

A. Differentiation of cartilage tissue

B. Formation of primary cartilage tissue

C. Formation of isogenic cell groups

D. Formation of a chondrogenic islet

E. Calcification of cartilage tissue

6. Electron micrograph of cartilage tissue shows flattened cells located in the perichondrium. The cytoplasm contains well-developed granular and agranular endoplasmic reticulum, the Golgi apparatus, and many free ribosomes. Indicate which cell is shown in the micrograph.

A. Chondroblast

B. Chondrocyte type I

C. Chondrocyte P type

D. Chondrocyte III type

E. Prechondroblast

7. It is known that with aging, the content of chondroitin sulfate in cartilage tissue decreases. What are the possible changes in the color of the intercellular substance in this regard?

A. Decreased basophilia

B. Reduction of oxyphilia

C. Color does not change

D. Increased basophilia

E. Increased oxyphilia

8. Clinical examination of an elderly woman revealed motor dysfunction associated with age-related changes in the articular cartilage. What changes in hyaline cartilage are typical for old age?

A. Calcification of the intercellular substance

B. Ingrowth of vessels into cartilage

C. Proliferation of chondroblasts

D. Thickening of the perichondrium

E. Swelling of the base substance

9. In a child with a severe injury of the upper limb, there is a violation of the regeneration of the cartilaginous tissue due to damage to the poorly differentiated cells of the cartilaginous diferon. Which cells have experienced damage?

A. Cells of the inner layer of the perichondrium

B. Cells of the outer layer of the perichondrium

C. Cells of isogenic groups

D. Cells of the young cartilage zone

E. Cells migrated from blood vessels

10. The student is offered two preparations stained with orsein. On the first - elastic cartilage, on the second - hyaline cartilage. How can you tell them apart?

A. By the presence of elastic fibers

B. By the presence of isogenic cell groups

C. By the presence of a zone of young cartilage

D. By the presence of the perichondrium

E. By the presence of an amorphous substance

11. Cartilage cells are characterized by different Hertwig index, which determines their specialization. What cells are considered the source of reproduction of isogenic groups?

A. Chondrocytes type I

B. Chondroblasts

C. Prechondroblasts

D. Chondrocytes type II

E. Chondrocytes type III

12. In an experimental study, chondrohistogenesis was damaged by the sclerotome. Which cells were differentiated under these conditions?

A. Chondroblasts

B. Smooth myocytes

S. Myoblastov

D. Fibroblasts

E. Neuroblasts

13. Due to chondrodysplasia (an anomaly in the development of cartilage), the fibrous cartilage is damaged. Where is it possible to observe pathological changes?

A. In the intervertebral discs

B. In the auricle

C. In the trachea

D. In the larynx

E. In the bronchi

14. Skeletal tissue is diagnosed in the preparation, in which cells are located in groups, there are no vessels in the intercellular substance, fibers are not determined. What tissue is present in the preparation?

A. Hyaline cartilage

B. Elastic cartilage

C. Lamellar bone

D. Fibrous cartilaginous

E. Reticulofibrous bone

15. On the histological preparation of hyaline cartilage, the perichondrium is absent. Indicate the organ from which this drug was possibly prepared.

A. Articular surface

V. Gortan

C. Trachea

D. Auricle

E. Intervertebral discs

16. In the composition of the cellular elements that form the cartilaginous tissue, a histogenetic series of cells can be distinguished. What cells are not part of the cartilaginous diferon?

A. Stem cells

B. Semistem cells

C. Chondroblasts

D. Chondrocytes

E. Chondroclasts

17. In a conditional experiment, a fragment of one of the germ layers was destroyed, as a result of which the cartilaginous tissue did not develop. Name which embryonic rudiment was destroyed.

A. Sclerot

B. Ectoderm

C. Endoderm

D. Dermotom

E. Miotom

18. It is known that several stages of development are distinguished in chondrogistogenesis. Indicate the processes characteristic of the stage of primary cartilage tissue formation.

A. Chondroblast formation

B. Formation of primary chondrocytes

C. Formation of isogenic cell groups

D. Formation of the perichondrium

E. Albumoid formation

19. In elderly patients, due to a violation of trophism in the cartilaginous tissue, an oxyphilic protein - albumoid is formed. Indicate the cartilage power source.

A. Vessels of the intercellular substance

B. Vessels of isogenic cell groups

C. Vessels of the perichondrium

D. Vessels of the surrounding connective tissue

E. Vessels of the periosteum

20. In the experiment, the chondrogenic islet was destroyed in the animal embryo, as a result of which the development of cartilage tissue was disrupted in this area. Indicate which cells were destroyed.

A. Chondroclasts

B. Chondrocytes type I

C. Type II chondrocytes

D. Chondrocytes III type

E. Chondroblasts

7. Materials for methodological support of self-training of students.

Main literature

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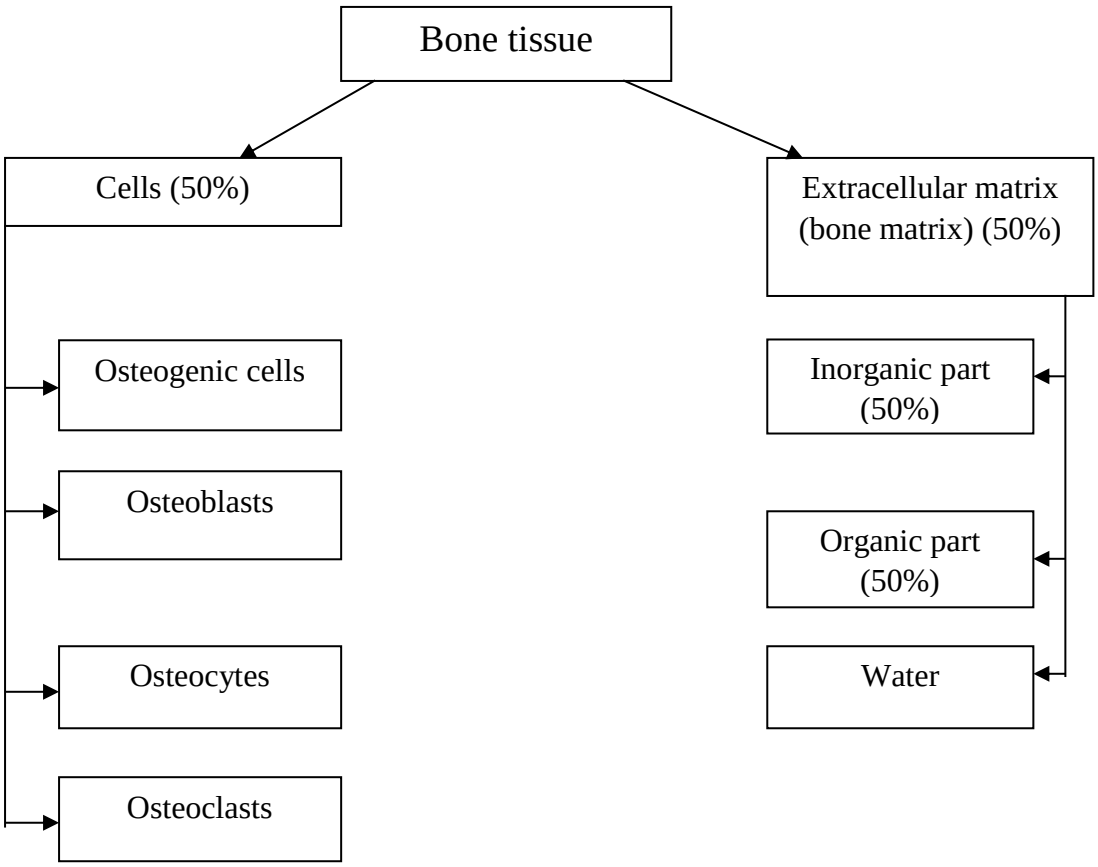
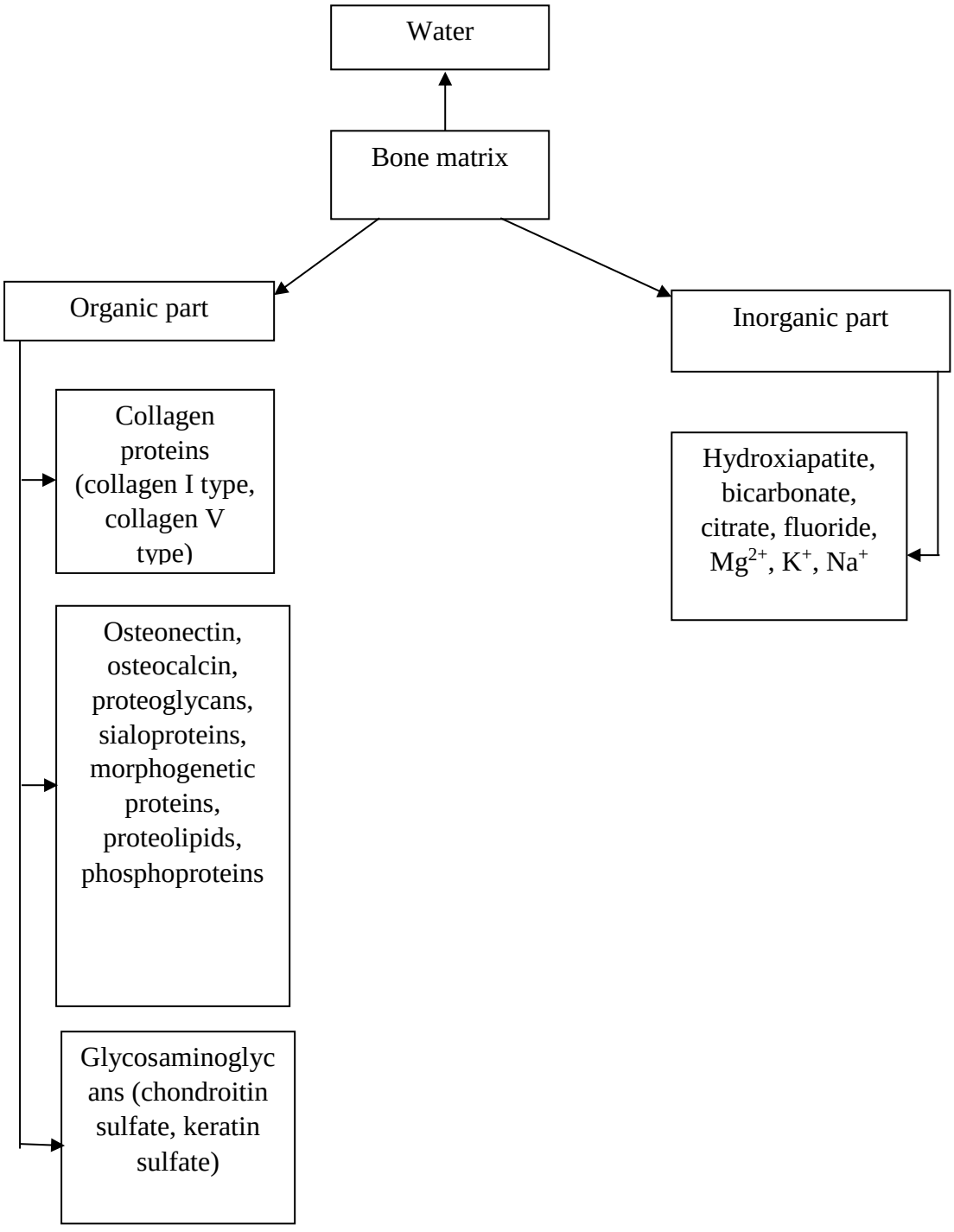
4. Topic content

Graph logical structure of the lesson




Water
Bone matrix
Organic part
Inorganic part
Collagen proteins (collagen I type, collagen V type)
Hydroxiapatite, bicarbonate, citrate, fluoride, Mg^{2+}, K^{+}, Na^{+}
Osteonectin, osteocalcin, proteoglycans, sialoproteins, morphogenetic proteins, proteolipids, phosphoproteins
Glycosaminoglycans (chondroitin sulfate, keratin sulfate)

5. Plan and organizational structure of the practical lesson

№ .	The main stages of employment, their functions and content.	Learning objectives in the levels of assimilation.	Training and control methods.	Materials for methodological support of the clarity of the lesson, control of the knowledge of those who are studying.	The term (in minutes or in%) of the total time of the lesson.
1	2	3	4	5	6

I. 1. 2. 3. 4. II 1. 2. III.	Preparatory stage. Organization of the lesson. Designation of educational goals and objectives. Control of the initial level of knowledge, skills and abilities. Readiness to absorb the material of the current lesson. The main stage Formation of students' skills and abilities (survey, interview-poll, testing, written assignments). Consolidation of knowledge and practical work of students with slides. The final stage. Summing up the results of the lesson. Providing homework.	I.Acquaintance II. Know III.Technique of execution IV.Research skills	Projector, TVs, computers. TVs, computers Microscope microscopic preparations, albums	Tables, slides, dummies, scheme, tests. Tables, set of tests, written assignments, situational tasks. Drawings from the atlas, electron diffraction patterns. List of literature, questions, tasks.	5 -15min. 30min 30-35min 5 min

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Test questions

1. Morphofunctional characteristics of bone tissue.

2. Describe the classification of bone tissue.

3. Describe the diferon of bone cells.

4. The structure, function and localization of osteoblasts.

5. Structure, function and localization of osteocytes

6. Describe the morphological and functional characteristics of osteoclasts.

7. Describe the structure of the intercellular substance of bone tissue.

8. Describe the structure and functional significance of the periosteum.

9. The structure and localization of the reticulofibrous bone.

10. Describe the structure of the lamellar bone.

11. Comparative characteristics of compact and cancellous bone tissue.

12. Describe the histological structure and growth of tubular bones.

13. List and describe the types of bone connections.

Questions for individual work.

1. The structure of reticulofibrous bone tissue.

2. Functions and structure of the endosteum and periosteum.

3. Connections of bones. Classification.

4. The structure of joints, articular cartilage, articular capsule, its structure.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. In the tubular bone between the osteons there are bone plates that do not form osteons. What are these records called?

2. It is known that the diameter of osteon canals increases with aging. How do these changes affect the mechanical properties of the bone?

3. On a histological specimen of the material of the cranial sutures, thick bundles of randomly arranged collagen fibers and lacunae with long anastomosing tubules are visible. What tissue is presented in the histological preparation?

4. An electron micrograph of one of the skeletal tissues shows parallel collagen fibers, and between them there are single process cells with weak development of organelles. Name this fabric.

5. A histological specimen of one of the skeletal tissues shows rounded formations formed by concentric plates, in the middle of which there is a canal. Name the organ from which this drug may have been made.

6. On a histological specimen of compact bone tissue, open bone plates are determined through which the vessels pass into the bone. Name this bone structure.

7. On a histological specimen of one of the skeletal tissues, thick bundles of randomly arranged collagen fibers and lacunae filled with cells with long anastomosing processes are visible. Name the organ from which this drug may have been made.

8. In the histological specimen of the femoral diaphysis, collagen fibers are seen penetrating into the bone from the side of the periosteum at different angles. Name these structures.

9. In histological preparations of tubular bones of a young generation of rats, a thin membrane lining the medullary cavity, containing numerous osteoblasts, is determined. Name this shell.

Microslides

1. Lamellar bone tissue - a cross section of the diaphysis of the tubular bone. Staining according to Schmorl.

Specimens for study

Specimen for examination 1. Lamellar bone tissue. Cross section of the diaphysis of the tubular bone. Bone tissue is decalcified. (Fig. 1).

Small magnification. Find the periosteum (periosteum) yellowish, brown or green. The outer general plates lie parallel under the periosteum. Deeper are the systems of concentric plates - osteons. At the center of each osteon is a central canal. Osteon is surrounded by a cleavage line. Between the osteons there are intercalation plates;

the inner general plates surround the medullary cavity. They are covered with a thin fibrous sheath - endost.

High magnification. In any plate, osteocytes are clearly visible, located in the lacunae parallel to the direction of the plate, and their processes, which pass in the bone tubules perpendicular to the direction of the plate.

Draw and designate: 1) osteon: a) osteon channel with blood vessels; b) bone plates; c) bone tubules; 2) a system of insertion plates;

3) resorption (cleavage) lines.

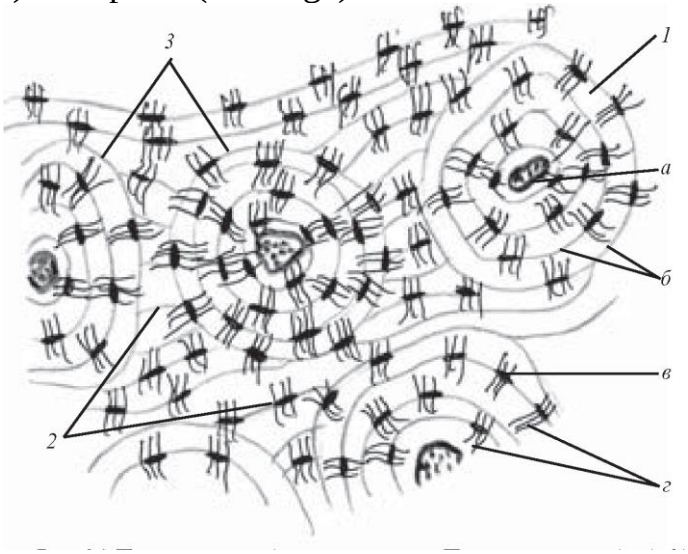


Figure: 1. Lamellar bone tissue. Cross section of the diaphysis of the tubular brush. Decalcified bone tissue. Staining according to Schmorl. × 400:

1 - osteon (a - osteon canal with blood vessels, b - bone plates; c - bone lacunae; d - bone tubules) 2 - insertion plate system; 3 - resorption (cleavage) line

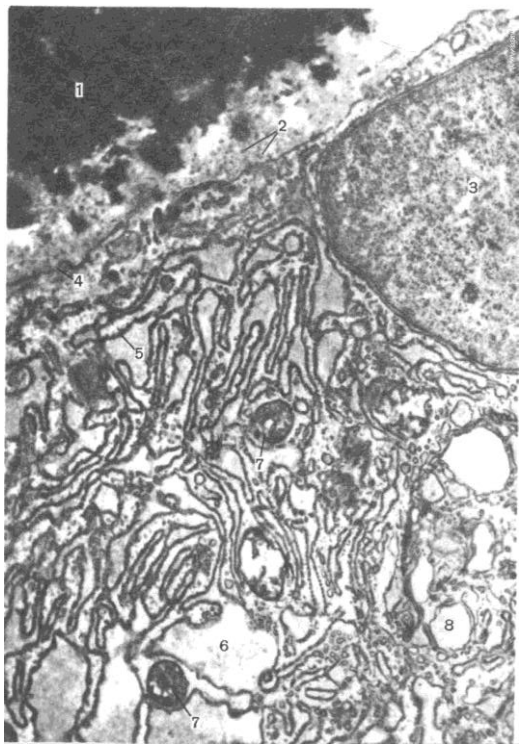
Electron micrographs

1. Osteoblast.

2. Osteocyte.

Osteoblast

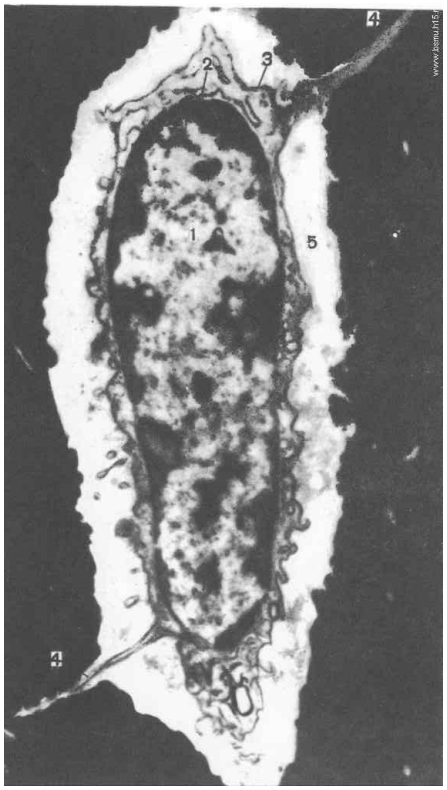
Osteoblast. Electronic microphotogram of osteoblast from the crus of a newborn mouse. × 16 000



1 – mineralized ground substance of a bone; 2 – osteoid with numerous collagen fibrils; 3 – nucleus of osteoblast; 4 – cytolemma of osteoblast; 5, 6 – endoplasmic reticulum; 7 - mitochondria; 8 – Golgi complex.

Osteocyte

Bone cell - osteocyte. Electronic microphotogram of bone cell of the femur of a mouse. × 10 000



1 - nucleus; 2 – endoplasmic reticulum; 3 – cell membrane (cytolemma); 4 – processes of osteocyte; 5 – bone lacuna; 6 – extracellular matrix of bone.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. Older people have osteoporosis - excessive loss of bone mass. Which bone tissue cells are activated causes the development of this disease?

A. Osteocytes

V. Osteoblasts

C. Osteoclasts

D. Fibroblasts

E. Macrophagov

2. The histopreparation presents a tissue containing large polar cells, devoid of processes and each having several tens of nuclei. One of the poles of the cell has numerous cytoplasmic outgrowths and an accumulation of lysosomes. What tissue is represented in the histopreparation?

A. Kostnaya

B. Cartilage

C. Epithelial

D. Reticular

E. Tight connecting

3. Osteocytes maintain the balance of calcium in the human body, forming a single functional system in the bone. What contacts between cell processes ensure the performance of their functions?

A. Tight contacts

B. Desmosomes

C. Insert Discs

D. Nexuses

E. Synapses

4. The histopreparation presents a tissue containing large polar cells, devoid of processes and each having several tens of nuclei. One of the poles of the cell has numerous cytoplasmic outgrowths and an accumulation of lysosomes. What kind of cells are they?

A. Fibroblasts

B. Osteoblasts

C. Osteoclasts

D. Chondrocytes

E. Osteocytes

5. A boy was admitted to the hospital with a traumatic injury to his upper limb. X-ray examination revealed a fracture of the humerus. Due to what structure will the reparative bone regeneration occur?

A. Layer of external general plates

B. Layer of inner general plates

C. Epiphysis

D. Diaphysis

E. Periosteum

6. In the composition of cellular elements that form bone tissue, a

histogenetic series of cells can be distinguished. What cells are not part of the bone tissue differon?

A. Stem osteogenic

B. Semi-stemmed

C. Osteoblasts

D. Osteoclasts

E. Osteocytes

7. In places of fractures, bones grow together due to the activation of osteoblasts. Which of the listed characteristics is not typical for them?

A. Collagen synthesis

B. Synthesis of proteoglycans

C. Secretion of alkaline phosphatase

D. Differentiation into osteocytes

E. Differentiation into osteoclasts

8. A patient was admitted to the clinic with a diagnosis of clavicle fracture. What cellular elements will take part in bone tissue regeneration?

A. Osteoblasts

B. Osteoclasts

C. Osteocytes

D. Chondrocytes

E. Fibroblasts

9. When analyzing the radiograph of a 57-year-old patient, the doctor drew attention to the local destruction of the hard tissues of individual bones. With the increased activity of which cells can these changes be associated?

A. Osteoblasts

V. Chondroblasts

C. Osteoclasts

D. Osteocytes

E. Chondrocytes

10. On the roentgenogram, callus appears at the site of the femur fracture in the upper third of the diaphysis. What tissue is formed in this case?

A. Cartilage

V. Gialinovaya

C. Tight connecting

D. Rough fibrous bone

E. Lamellar bone

11. A histological preparation of bone tissue shows a large cell containing seven nuclei. One side of it is adjacent to the bony crossbar and contains many cytoplasmic outgrowths (corrugated border). What is the function of this area of the cell?

A. Tight fit

B. Energy generation

C. Secretion of hydrolytic enzymes

D. GAG secretion

E. Collagen secretion

12. Presented is a histological specimen made from the flat bone of the embryo. One can see thick bundles of collagen fibers, oval-shaped lacunae, filled with bone cells with long processes. What arrangement should collagen fibers have in this preparation?

A Strictly parallel

B. Disordered

C. Crossed at a specific angle

D. Forming parallel plates

E. Forming Concentric Plates

13. In the postembryonic period, the human skeleton is formed by lamellar and reticulofibrous bone tissue. What is the location of the reticulofibrous bone tissue?

A. In the epiphyses of tubular bones

B. In the bones of the skull

C. In the seams of the bones of the skull

D. In the bones of the pelvis

E. In the sternum and ribs

14. It is known that there are insertion plates in the diaphysis of the tubular bone. Indicate the location of their localization.

A. Form osteons

B. Form external general plates

C. Form internal general plates

D. Form cleavage lines

E. Between osteons

15. Anatomically, the tubular bones consist of the diaphysis and the pineal gland, which are interconnected by metaphyseal cartilage during the growth of the organism. In each of these structures, a number of layers are distinguished. Indicate which layer is isolated in the diaphysis of the tubular bone.

A. Bubble

V. Columnar

S. Border

D. Osteonic

E. Central

16. It is known that osteocytes are bone cells that have lost the ability to divide. They have a process-like shape, a relatively large core. Indicate their location in the bone tissue.

A. Osteon Channels

B. Bone lacunae

S. Endost

D. Periosteum

E. Bone marrow cavity

17. Intercalated bone plates in the diaphysis of the tubular bone are located between osteons and have a

structure similar to osteonic plates. Kazkovo their purpose in lamellar bone tissue?

A. Source of formation of external or internal bone plates

B. Source of Osteon Formation

C. Remains of previous osteons

D. Part of newly formed osteons

E. Remains of coarse fibrous bone tissue

18. Bone tissue, as a kind of skeletal connective tissue, consists of cells and intercellular substance and has its own structural and origin features. Indicate what is not typical for lamellar bone tissue.

A. Forms compact and cancellous bone

B. Appositional growth

C. Collagen type III

D. Orderly arrangement of collagen fibers

E. Osteon channels contain blood vessels

19. An electron micrograph of bone tissue revealed multinucleated cells, the cytoplasm of which contains numerous lysosomes. What cells are represented on the electronogram?

A. Osteoclasts

B. Osteoblasts

C. Osteocytes

D. Preosteoblasts

E. Osteogenic cells

20. In children with a sedentary lifestyle, hypokinesia is noted, which leads to a decrease in the rate of bone growth. How does the functional activity of bone cells change?

A. Osteoblast decreases

B. Osteocyte decreases

C. Does not change

D. Osteoblast increases

E. Osteocyte increases

7. Materials for methodological support of self-training of students.

Main literature

1. Histology, cytology. embryology. / Ed. Units Lutsyk, Y.B. Tchaikovsky // Pidruchnik.Vinnitsa "New book", - 2018. - 591 p.

2. Afanasyev Yu.I. Histology / Ed. Yu.I. Afanasyeva, N.A. Yurina // M .: Medicine, -1983,1989,1999, 2012.

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4. Barinov EF Cytology and general embryology. / Ed. E.F.Barinova,

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7. Tchaikovsky Yu.B. Histology, cytology and embryology / Yu.B. Tchaikovsky, L.M. Sokurenko // Atlas for students' independent work. Lutsk - 2006. - 152 p.

8. Histology / Ed. Yu.I. Afanasyeva, N.A. Yurinoi. M: Medicine, 1989, pp. 171-186.

Additional literature

1. Laboratory studies in the course of histology, cytology and embryology / Under. Ed. Yu.I. Afanasyeva. M: High school. 1990.

2. Napkhanyuk V.K., Servetsky K.L. Workshop on cytology, general histology and embryology. Tutorial. Odessa, 1999.

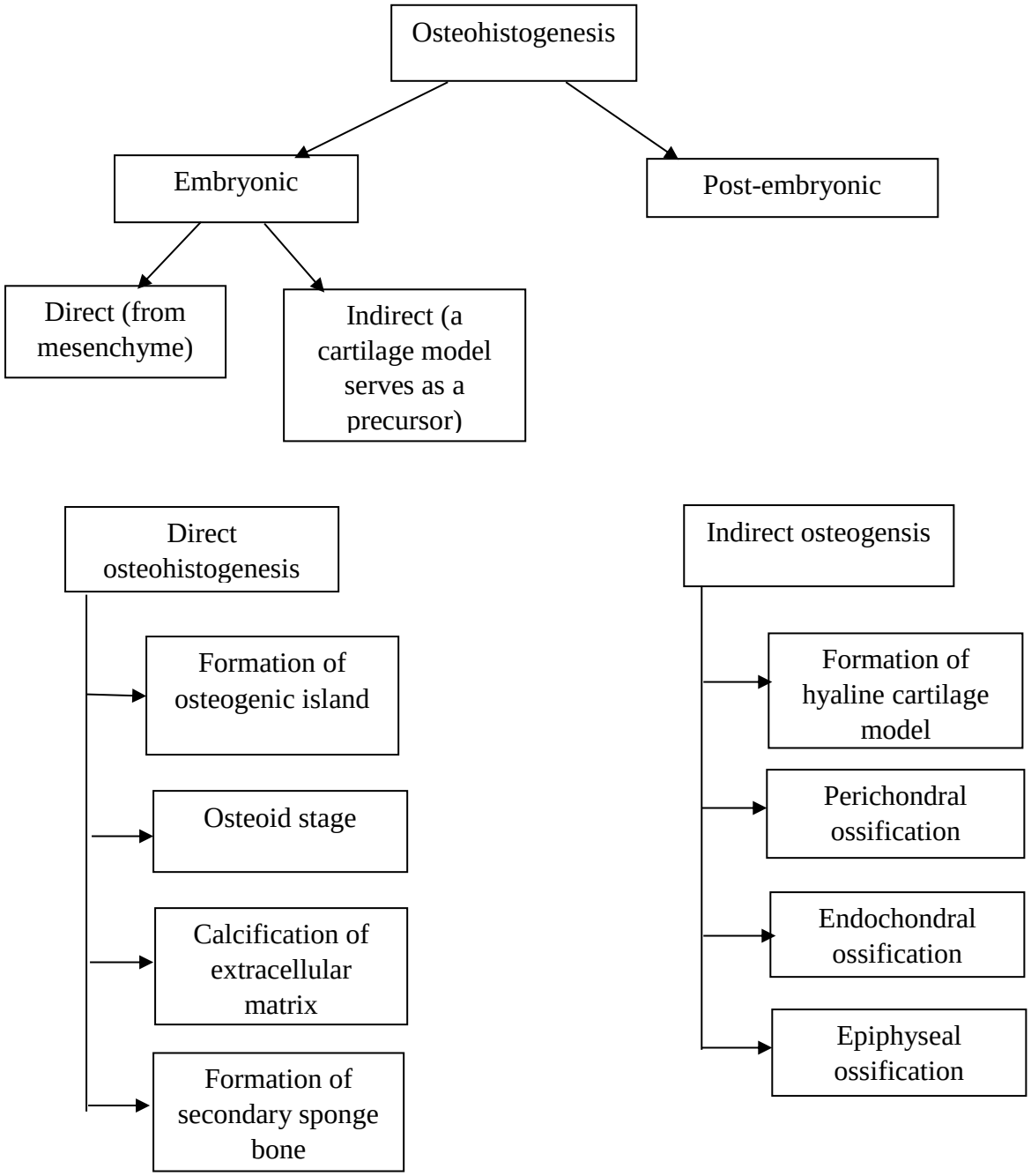
3. Workshop on histology, cytology and embryology / Under. Ed. N.A. Yurinoi, A.I. Radostinoi. M: Publishing house of UDN. 1989.

4. Almazov IV, Sutulov L.S. Atlas of Histology and Embryology. M .: Medicine, 1978.

5. Napkhanyuk V.K. Fundamentals of cytology, general histology and embryology (course of lectures). Odessa. 1999.

4. Topic content

Graph logical structure of the lesson



5. Plan and organizational structure of the practical lesson

№ .	The main stages of employment, their functions and content.	Learning objectives in the levels of assimilation.	Training and control methods.	Materials for methodological support of the clarity of the lesson, control of the knowledge of those who are studying.	The term (in minutes or in%) of the total time of the lesson.
1	2	3	4	5	6

I.	Preparatory stage.				
1.	Organization of the lesson.	I.Acquaintance	Projector, TVs, computers.	Tables, slides, dummies, scheme, tests.	5 -15min.
2.	Designation of educational goals and objectives.	II. Know			
3.	Control of the initial level of knowledge, skills and abilities.				
4.	Readiness to absorb the material of the current lesson.			Tables, set of tests,	
II	The main stage Formation of	III.Technique of execution	TVs, computers	written assignments,	
1.	students' skills and abilities (survey, interview-poll, testing, written assignments).	IV.Research skills		situational tasks. Drawings from the atlas, electron diffraction patterns.	30min
2.	Consolidation of knowledge and practical work of students with slides.			List of literature, questions, tasks.	30-35min
III.	The final stage. Summing up the results of the lesson. Providing homework.		Microscope microscopic preparations, albums		5 min

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. General characteristics of osteohistogenesis.

2. Sources of bone tissue development.

3. Name the stages of direct osteohistogenesis.

4. Formation of the osteogenic rudiment.

5. Osteoid formation.

6. Formation of primary cancellous bone.

7. Formation of secondary cancellous bone.

8. Describe the stages of indirect osteohistogenesis.

9. Formation of a cartilaginous model.

10. Perichondral ossification.

11. Endochondral ossification.

12. Formation of the epiphyseal (secondary) center of ossification.

13. Describe the histological structure and growth of tubular bones.

Questions for individual work.

1. Factors affecting the development and growth of bones.

2. Age-related changes in bone tissue.

3. Growth and regeneration of bone tissue.

4. Exo- and endogenous factors affecting the structural homeostasis of bone tissue.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. Before puberty, the growth of an organism depends on the ability of bone tissue to grow in length. What bone structures provide this?

2. After the onset of puberty in a person, the growth of tubular bones in length ends. A decrease in the proliferation of which cells in the composition of tubular bones causes the cessation of bone growth in length?

3. It is known that with aging the diameter of osteon canals increases. How do these changes affect the mechanical properties of the bone?

4. The reconstruction of bone tissue throughout a person's life is accompanied by resorption - the destruction of bone tissue by activated steoblasts. What enzyme secreted by these cells breaks down collagen fibers?

5. Connections of bones to each other in the skeleton can have a different structure. Specify the type of bone connection using cartilage.

Microslides

1. Development of bone tissue from the mesenchyme (cross section of the jaw of the embryo of the animal). Hematoxylin-eosin staining.

2. Development of bone tissue at the site of cartilage. Hematoxylin-eosin staining.

Specimens for study

Specimen for examination 1. Development of bone tissue from the mesenchyme (Fig. 1).

Small magnification. Find areas of coarse-fibrous bone tissue (osteoid) on the specimen, homogeneously stained in bright pink. The islets are surrounded by cells of the mesenchyme - an adherent form with a weakly basophilic cytoplasm. On the surface of the osteoid are osteoblasts - polygonal cells with sharply basophilic cytoplasm. In the depths of the osteoid, osteocytes are located - cells with a clear rim of the cytoplasm. Osteoclasts are multinucleated cells.

High magnification. On the side of the osteoclasts facing the bone, a corrugated edge is visible. Blood vessels are defined as transverse and oblique sections of thin-walled tubules containing shaped elements. Draw and designate: 1) skeletal islet; 2) mesenchyme; 3) a blood vessel; 4) bone trabecula: a) osteocytes; b) basic substance - osteoid; 5) osteoblasts; 6) osteoclast.

Figure: 1. Development of bone tissue from the mesenchyme. Hematoxylin-eosin staining. × 400:
1 - skeletal islet; 2 - mesenchyme; 3 - blood vessel; 4 - bone trabeculae (a - calcified intercellular substance, b - osteocytes; c - uncharged basic substance - osteoid) 5 - osteoblasts; 6 - osteoclast

Specimen for examination 2. Development of bone in place of cartilage (Fig. 2). *Small magnification*. Find the zone of the diaphysis of the cartilaginous anlage on the specimen. In this area, under the perichondrium, the perichondral bone ring (bone cuff) is visible. The intercellular substance in it is homogeneous pink in color, and the osteoblasts and nuclei are osteocytes
- basophilic. In the central zone of the diaphysis, where endochondral ossification occurs, endochondral bone forms around the blue and blue areas of the uncharged cartilage matrix. In the bone cavity, clusters of red bone marrow cells are visible (round-shaped cells, often with hyperchromic nuclei). On the border with the pineal gland there is a zone of cartilage resorption, where uncharged cartilage is destroyed and replaced by bone tissue. Further, there is a zone of hypertrophy, in which chondrocytes look like transparent vesicles. Behind it is the proliferation zone, in which chondrocytes multiply, arranged one after another in the form of coin columns. Most of the pineal gland is occupied by a zone of unchanged hyaline cartilage. Draw and designate: 1) epiphyseal hyaline cartilage; 2) perichondrium; 3) columnar layer; 4) a vesicular layer; 5) perichondral bone cuff; 6) a layer of calcified cartilage; 7) endochondral bone; 8) a blood vessel; 9) the channel of the primary osteon; 10) bone marrow; 11) the periosteum.

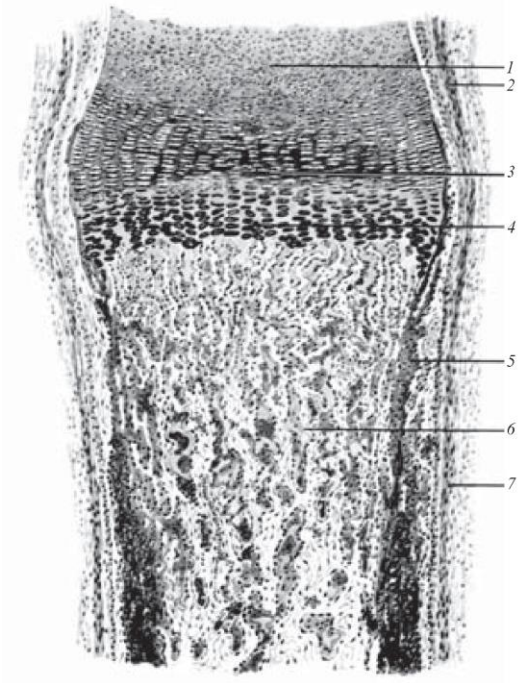


Figure: 2. Development of bone in place of cartilage. Hematoxylin-eosin staining. × 56:
1 - epiphyseal hyaline cartilage; 2 - perichondrium; 3 - a layer of columnar cartilage; 4 - a layer of vesicular cartilage; 5 - perichondral bone cuff; 6 - endochondral bone; 7 – periosteum

6.3. Control materials for the final stage of the lesson.

Test tasks

1. In the experiment, one of the embryonic layers was destroyed, as a result of which the bone tissue did not receive its development. Name which embryonic rudiment was destroyed.

A. Ectoderm

B. Endoderm

S. Sclerot

D. Dermatome

E. Miot

2. It is known that in indirect osteohistogenesis, perichondral and enchondral ossification is distinguished. Indicate where the process of perichondral ossification begins.

A. From the formation of the bone cuff

B. With the formation of the bone marrow cavity

C. From the germination of blood vessels into uncharged cartilage

D. From the formation of the center of ossification in the pineal gland

E. With the formation of the endosteum

3. In the experiment, the course of the fourth stage of direct osteohistogenesis was disturbed. What process will not take place in this case?

A. Endosteum formation

B. Formation of the periosteum

C. Formation of lamellar bone

D. Calcification

E. Osseomucoid formation

4. It is known that in direct osteohistogenesis there are four periods of bone tissue development. Indicate the starting point for this process.

A. Impregnation with salts of the intercellular substance

B. Focal multiplication of mesenchymal cells

C. Formation of the periosteum

D. Ingrowth of blood vessels

E. Endosteum formation

5. It is known that indirect osteohistogenesis begins from the 2nd month of the embryonic period with the establishment of the cartilaginous primordium. Indicate the process by which the replacement of cartilage tissue with bone begins.

A. With degenerative changes in the steobl of the cartilaginous primordium

B. With differentiation in the perichondrium of osteoblasts

C. With the formation of the bone cuff

D. With the formation of primary osteons

E. From the formation of the bone marrow cavity

6. It is known that in indirect osteohistogenesis, the dissolution of the calcified intercellular substance of the cartilage occurs under the influence of enzymes. Name the source of their selection in the bone bud.

A. Brought by blood

B. Secreted by steoblasts

C. Secreted by osteoblasts

D. Secreted by osteocytes

E. Secreted by vacuolated chondrocytes

7. In the histogenesis of bone tissue, two ways of its development are possible. What stages are not inherent in direct osteohistogenesis?

A. Replacement of coarse fibrous bone with lamellar

B. Formation in the osteogenic islet

C. Osteoid formation

D. Formation of coarse fibrous bone

E. Formation of the epiphyseal center of ossification

8. It is known that in the direct development of bone tissue from the mesenchyme, several stages are distinguished. Indicate which stage is not typical for the development of bone tissue in this way.

A. Formation of a zone of vesicular cells

B. Formation of a skeletal islet

C. Cell differentiation

D. Replacement of coarse fibrous bone with lamellar

E. Calcifications

9. One of the conditions for the formation of bone tissue is the formation of the periosteum. Specify the period of direct osteohistogenesis, in which the periosteum is formed.

A. Formation of a skeletal islet

B. Cell differentiation

C. Calcification

D. Replacement of coarse fibrous bone tissue with lamellar

E. Reproduction of osteogenic cells

10. It is known that in indirect osteohistogenesis during the formation of a bone cuff that disrupts cartilage nutrition, dystrophic changes in the bone anlage occur. Indicate the consequences of this process.

A. Vesicular chondrocytes appear

B. Chondroblasts are differentiated

C. The perichondrium is formed

D. Cartilage growth is activated

E. Bone plates are forming

11. Osteonectin is known to mediate calcification and selectively binds calcium and phosphorus salts to collagen. What is osteonectin by nature?

A. Glycoprotein

B. Glycosaminoglycan

C. Phospholipid

D. Lipoprotein

E. Hydroxyapatite

12. A 5-month-old child was admitted to the clinic with changes in the skeletal system: some softening of the flat bones of the skull, an increase in the size of fontanelles, characteristic swelling of the ribs. The child was diagnosed with rickets. What factor causes this disease?

A. Violation of protein metabolism

B. Violation of water-salt metabolism

C. Lack of vitamin D

D. Lack of vitamin C

E. Excess calcitonin

13. In a 12-year-old child who complained of stunted growth, suppression of the formation of collagen fibers and a decrease in the phosphatase activity of osteoblasts were found. What can contribute to these clinical manifestations?

A. Excess vitamin C

B. Vitamin C deficiency

C. Vitamin D deficiency

D. Excess vitamin D

E. Calcitonin deficiency

14. With premature puberty, ossification of the metaepiphyseal cartilaginous growth plate accelerates. How will this affect the patient's growth?

A. Early growth arrest will occur

B. Growth will accelerate

C. Will not affect the growth of the patient

D. Physiological bone regeneration will increase

E. Increased bone growth in width

15. A child of 11 years old noticeably lags behind his peers in growth. What structures support the growth of tubular bones in length?

A. Metaphyseal cartilage

V. Osteon

S. Gaversov canal

D. Endost

E. Periost

16. On the preparation of human tubular bone there is no metaepiphyseal growth plate. What is the likely age of the person?

A. Less than 5 years

B. 5 - 10 years

S. 10 - 15 years

D. 15 - 20 years old

E. More than 20 years

17. An animal with an experimental bone fracture was injected with the hormone calcitonin, which stimulates the function of osteoblasts. What changes in bone tissue are possible with the introduction of calcitonin?

A. steoblasts

B. Slow down regeneration

C. Acceleration of regeneration

D. Hypermineralization

E. There will be no changes

18. It is known that the growth of tubular bone in width is carried out by the formation of concentric layers of fine-fibrous bone (steoblast growth). What bone structures provide this?

A. Periosteum

B. Epiphysis

S. steob

D. Metaepiphyseal plate

E. Epiphyseal centers of ossification.

19. It is known that during life, bone tissue undergoes physiological, and sometimes, reparative regeneration, accompanied by local destruction of bone tissue. What substance is involved in the dissolution of coltium salts?

A. Citric acid

B. Osteonectin

C. Blood glycerophosphates

D. Carbonic anhydrase

E. Alkaline phosphatase

20. During a medical examination of the kindergarten children, the doctor found that the children's diet was insufficient in calcium salts. What disorders can occur in the development of skeletal tissue?

A. Bone hypomineralization

B. Hypermineralization of bones

C. steoblasts and cartilage

D. Hypermineralization of cartilage

E. No change

METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. General morphofunctional characteristics of muscle tissue.
2. Describe the classification of muscle tissue.
3. Name the source of development of skeletal muscle tissue.
4. Localization and functional features of skeletal muscle tissue.
5. Features of the structure of skeletal muscle tissue.
6. The contractile apparatus of the striated muscle fiber.
7. Describe the structural and functional unit of the myofibril - sarcomere.
8. Describe the morphofunctional characteristics of myosatelytocyte cells.
9. Describe the structure of a muscle as an organ.
10. Describe the structure and function of all types of muscle fibers.

Questions for individual work.

1. Types of muscle fibers.
2. Construction of muscle as an organ.
3. Regeneration and transplantation of muscle tissue.
4. Age-related changes.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. Muscle tissue belongs to the group of special tissues and has certain morphological and functional characteristics. What is not typical for muscle tissue?

2. Muscle tissue belongs to the group of special tissues and has certain morphological and functional characteristics. What is not typical for muscle tissue?

3. Cross-lined muscle tissue contains myofibrils, the structural and functional unit of which is its section between:

4. According to their functional characteristics, muscle fibers are divided into fast, slow and intermediate. Which of these properties is not typical for fast fibers?

5. According to their functional characteristics, muscle fibers are divided into fast, slow and intermediate. Which of these properties is not typical for slow fibers?

Microslides

1. Striated muscle tissue of the tongue. Iron hematoxylin staining.

Specimen for examination 1. Striated muscle tissue of the tongue (Fig. 1).
Small magnification. With this magnification, find bundles of transverse muscle fibers, cut in different directions, basophilic stained, with many nuclei of a dark purple color, lying under the sarcolemma (on the longitudinal and transverse sections).
High magnification. The longitudinal section clearly shows the alternation of dark and light basophilic stripes. Between the muscle fibers there are layers of loose connective tissue (endomysium). Draw and designate: 1) muscle fibers in a longitudinal section; 2) muscle fibers in cross section; 3) endomysium; 4) blood vessels; 5) fat cells.

Figure: 1 Striated muscle tissue of the tongue. Iron hematoxylin staining. × 400:
1 - muscle fibers in a longitudinal section; 2 - muscle fibers in a longitudinal section;
3 - endomysium; 4 - blood vessels; 5 - fat cells.

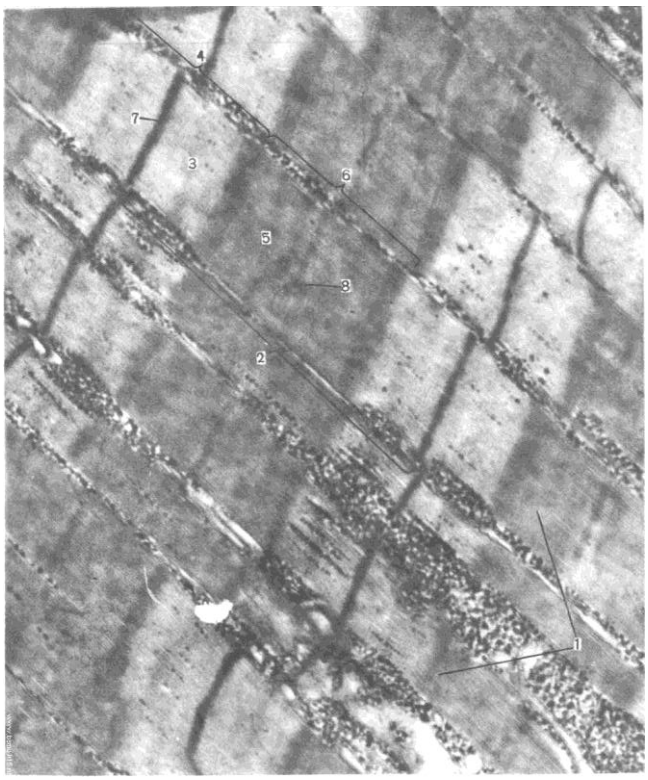
Electron micrographs

1. Striated muscle fiber.

2. The sarcomere of skeletal muscle fiber.

Striated muscle fiber

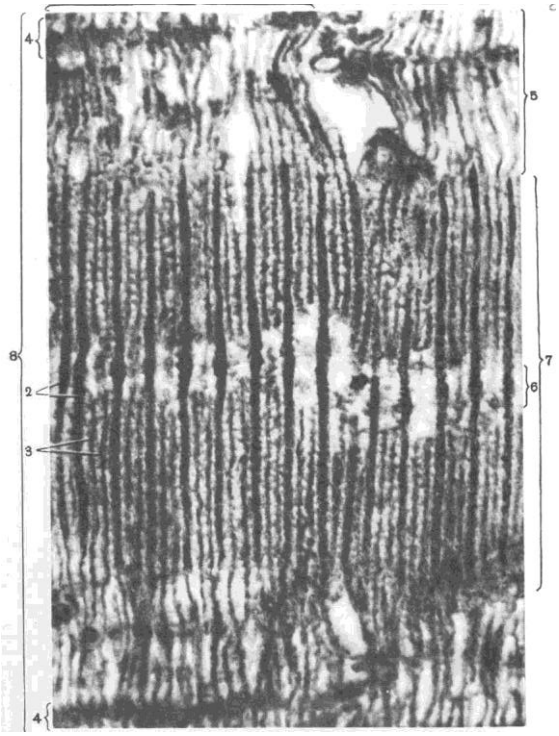
Striated muscle fiber. Electronic microphotogram of muscle fiber from skeletal muscle of axolotl. × 27 000



1 – striated myofibrils; 2 - sarcomere; 3 - ½ of I-band; 4 - 1/2 of A-band; 6 – A-band; 7 – Z-line; 8 – M-line.

Sarcomere of skeletal muscle fiber

Thin (actin) and thick (myosin) myoprotofibrils. Electronic microphotogram of striated myofibrils. × 175 000



1 – part of striated myofibril; 2 – thick (myosin) myoprotofibrils (myofilaments) ; 3 – thin (actin) myoprotofibrils (myofilaments); 4 – Z (T)-line (telophragm); 5 – part of I-band; 6 – M-line (mesophragm); 7 - A-band; 8 - sarcomere.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. During the formation of muscle tissue in embryogenesis, the process of fusion of myoblasts into myosimplasts is blocked. Which muscle tissue development will be impaired?

A. Myoepidermal

V. Mionevralnaya

S. Skeletnaya

D. Smooth

E. Cardiac

2. When examining injured striated muscle tissue, destruction of thick myofilaments is observed. In what part of the myophobril will pathological changes be localized when studying the fibers in polarized light?

A. In the telophragm

B. Disc I

C. In disk A

E. In disc A and in disc I

E. In half of disk I

3. When examining injured striated muscle tissue, destruction of thick myofilaments is observed. Which supporting structures connected to myosin filaments are also damaged?

A. Telophragm

B. Mesophragm

C. Cytolemma

D. T-system

E. L-system

4. In the study of striated muscle fiber after the action of hydrolytic enzymes, the destruction of thin myofilaments is observed. What supramolecular structures have suffered damage?

A. Actin filaments

B. Myosin filaments

C. Tonofibrils

D. Tropocollagen complexes

E. Nucleoprotein complexes

5. In trained individuals and athletes, there is a general increase in skeletal muscle mass. An increase (hypertrophy) of what types of muscle fibers occurs predominantly in these people?

A. Belykh

V. Krasnykh

C. Intermediate

D. Conducting

E. Gladkikh

6. A histological specimen shows muscle tissue, the main structural unit of which is a fiber consisting of symplast and myosatellitocytes, covered with a common basement membrane. What tissue is this structure typical for?

A. Myoepithelial

V. Mionevralnaya

S. Smooth

D. Cardiac

E. Skeletnoy

7. It is known that the transverse striation of the muscle fiber is due to the regular alternation of light (I-) and dark (A-) discs with a light H-zone in the latter. How will the width of the H-zone change with the maximum contraction of the muscle fiber?

A. Will not change

B. Will double

C. Will decrease by half

D. Will take up the entire sarcomere

E. Will disappear

8. It is known that the transverse striation of the muscle fiber is due to the regular alternation of light (I-) and dark (A-) discs with a light H-zone in the latter. How will the width of the A-disk change with the maximum contraction of the muscle fiber?

A. Will not change

B. Will double

C. Will decrease by half

D. Will take up the entire sarcomere

E. Will disappear

9. It is known that the transverse striation of the muscle fiber is due to the regular alternation of light (I-) and dark (A-) discs with a light H-zone in the latter. How will the width of the I-disc change with the maximum contraction of the muscle fiber?

A. Will not change

B. Will double

C. Will decrease by half

D. Will take up the entire sarcomere

E. Will disappear

10. As a result of an injury in a 14-year-old child, the leg muscles are damaged. What structures will be the source of reparative regeneration of skeletal muscle fibers?

A. Myofibrils

B. Myofilaments

C. Myosatellitocytes

D. Sarcolemma

E. Endomisium

11. During the experiment, the myotome was damaged in the rabbit embryo. What tissue development disorder was caused by this manipulation?

A. Skeletal muscle

B. Smooth muscles of the iris

C. Connective tissue of the skin

E. Smooth muscle

E. Serous membranes

12. It is known that calcium ions, along with other factors, promote muscle contraction. What proteins does calcium interact with during contraction?

A. Actin

V. Myosin

S. Troponin

D. Actinomyosin complex

E. Spectrin

13. A preparation of muscle tissue was delivered to the laboratory for research. The specimen shows fibers with a large number of nuclei located on the periphery. What kind of tissue is shown on the preparation?

A. Cardiac

B. Skeletal

S. Smooth

D. Myoepithelial

E. Mioneural

14. In the laboratory of electron microscopy, differential diagnostics of different types of muscle tissue is carried out. Which of the following structural features is characteristic only of skeletal muscle tissue?

A. Pinocytic vesicles and caveolae

B. Anastomoses

C. Insert Discs

D. Myosatellitocytes

E. T-system

15. Disorders of neuromuscular transmission were found in a patient after a traumatic injury to skeletal muscles. What is the system responsible for conducting nerve impulses deep into the muscle fiber (T-system) formed?

A. Sarcoplasmic reticulum;

B. The basement membrane;

C. Endomisium;

D. Telophragm;

E. Plasmolloma.

16. Electron microscopic examination of skeletal muscle tissue revealed alternation of light and dark discs. What is the formation of the light I-disc of the myofibril?

A. Actin

B. Myosin

C. Actin and partly myosin

D. Myosin and partly actin

E. Mesophragm

17. In the experiment, the animal was injected with drugs with acetylcholinesterase activity, which led to disruption of the activity of the T-system of skeletal muscle tissue? What is its functional significance?

A. Synthesis of high-energy compounds

B. Deposition of high-energy compounds

C. Initiation of glycogen breakdown

D. Deposition of Ca ions

E. Transmission of nerve impulses

18. A histological examination of the skeletal muscle tissue specimen revealed cells - myosatellitocytes. Which of the following signs is not typical for them?

A. Included in the Mion

B. Are located under the basement membrane

C. Contain one core

D. Contain myofibrils

E. Carry out cambial function

19. A victim with a traumatic muscle rupture was delivered to the clinic. Suturing of soft tissues was performed. Which of the following structures is not part of the muscle as an organ?

A. Endomisium

B. Vessels and nerves

C. Perimisium

D. Epimisium

E. Adipose tissue layers

20. A patient has a violation of the contractile activity of muscles due to a violation of calcium metabolism. In which structures of the muscle fiber is calcium ions deposited?

A. Mitochondria

B. Terminal tanks

C. Lamellar complex

D. T-tubules

E. Basement membrane

METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

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Minutes No. 2 of "26" September 2022.

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Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. General morphofunctional characteristics of muscle tissue.
2. Describe the classification of muscle tissue.
3. Name the sources of development of cardiac and smooth muscle tissues.
4. Features of the structure and function of cardiac muscle tissue.
5. The contractile apparatus of the striated cardiac muscle fiber.
6. What is the classification of cardiomyocytes?
7. Describe the structural features and types of conducting cardiomyocytes.
8. Localization and functional features of smooth muscle tissue.
9. Describe the structure of smooth muscle tissue myocytes.
10. Molecular mechanisms of muscle fiber contraction

Questions for individual work

1. Methods of regeneration of various types of muscle tissue.
2. Age-related changes in muscle tissue.
3. Muscle tissue of neural origin
4. Myoepithelial cells, structural features.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situatinal tasks

1. A histological specimen of the heart muscle revealed two types of cardiomyocytes - contractile and conducting. Which of the following signs is not typical for contractile cardiomyocytes?

2. On the preparation of the cardiac muscle tissue, it can be seen that each structural unit is delimited from the neighboring one by the so-called insertion discs. Which of the following signs is not typical for them?

3. For differential diagnosis in the histological laboratory preparations of muscle tissue are presented. Which of the following structural features distinguishes cardiac from skeletal muscle tissue?

4. When examining cardiac muscle tissue, it was found that atrial cardiomyocytes are different from ventricular cardiomyocytes. Which of the following signs are not characteristic of atrial muscle cells?

5. On the electron micrograph of the myocyte, dense bodies are determined, fixing actin filaments with each other. What protein do they contain?

Microslides

1. Smooth muscle tissue. Hematoxylin-eosin staining.

2. Cardiac muscle tissue. Iron hematoxylin staining.

Specimen for examination 1. Smooth muscle tissue of the urinary bladder (Fig. 1).
Small magnification. With this increase, find the muscular membrane of the organ.
High magnification. Smooth myocytes are clearly visible, which have a fusiform shape in a longitudinal section. The cytoplasm is oxyphilic. In the center of the cell is a violet rod-shaped nucleus. Between the longitudinal and circular muscle layers, layers of loose fibrous connective tissue are visible. Draw and designate: 1) smooth muscle cells in a longitudinal section; 2) smooth muscle cells in cross section; 3) layers of connective tissue with blood vessels; 4) the nucleus of a smooth muscle cell.

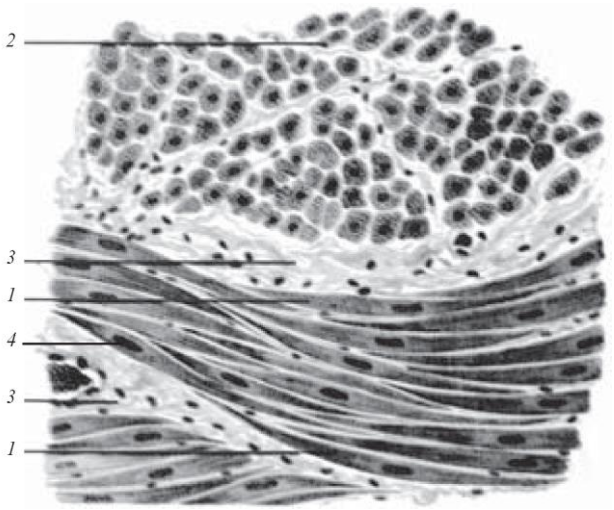


Figure: 1. Smooth muscle tissue of the bladder. Hematoxylin-eosin staining. × 400:

1 - smooth muscle cells in longitudinal section; 2 - smooth muscle cells in cross section; 3 - layers of connective tissue with blood vessels; 4 - the nucleus of a smooth muscle cell

Specimen for examination 2. Striated muscle tissue of the heart (Fig. 2).

Small magnification. Find the muscle fiber in longitudinal section.

Great magnification. The preparation clearly shows that the muscle fiber consists of cells - cardiomyocytes, almost rectangular in shape, in the center there are one or two nuclei. Inserted discs in the form of dark stripes are perpendicular to the long axis of the fiber. With such an increase, it is possible to consider the association of cardiac muscle fibers - anastomoses. At the light-optical level, the transverse striation of myofibrils is noticeable as the striation of the entire fiber.

Draw and designate: 1) cardiomyocyte; 2) the nucleus of the cardiomyocyte; 3) intercaleted disk; 4) layers of connective tissue with blood vessels; 5) anastomosis between two muscle fibers.

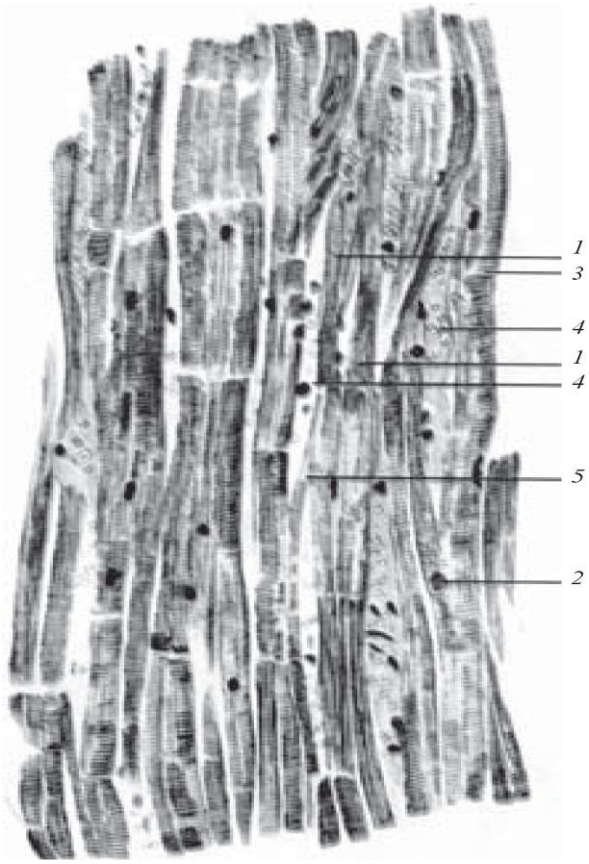


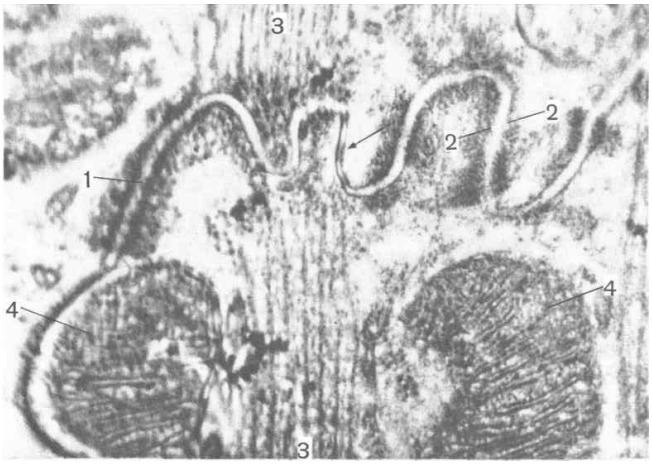
Figure: 2. Striated muscle tissue of the heart. Iron hematoxylin staining. × 320:
1 - cardiomyocyte; 2 - cardiomyocyte nucleus; 3 - intercaleted disk; 4 - layers of connective tissue with blood vessels; 5 - anastomosis between two muscle fibers

Electron micrographs

1. Cardiac muscle tissue. Insert discs.

Intercalated disks between cardiac muscle cells

Intercalated disk between cardiac muscle cells of the guinea pig myocardium. Electronic microphotogram. × 76 000



1 – intercalated disk (the border between muscle cells); 2 - sarcolemma; 3 - myofibrils; 4 – mitochondria.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. In the mechanism of contraction of structural muscle elements, the leading role is played by calcium ions, which are deposited in certain intracellular structures at the time of relaxation. Name these structures in relation to smooth muscle tissue.

A. Smooth EPS

B. Granular EPS

C. Pinocytic vesicles

D. Vacuoles

E. Golgi complex

2. Cross-lined cardiac muscle tissue contains myofibrils, the structural and functional unit of which is its section between:

A. A-discs

B. I-discs

C. Mesophragms

D. Telophragms

E. H-stripes

3. Muscle tissue belongs to the group of special tissues and has certain morphological and functional characteristics. What is not typical for muscle tissue?

A. Glycogen

V. Smooth EPS

C. Granular EPS

D. Interdigitation

E. Aktin

4. Muscle tissue belongs to the group of special tissues and has certain morphological and functional characteristics. What is not typical for muscle tissue?

A. Basement membrane

B. Nexuses

C. Mitochondria

D. Spherical shape

E. Myoglobin

5. Muscle tissue of epidermal origin is presented to the laboratory for research. What structure is the morphofunctional unit of such muscle tissue?

A. Muscle tube

B. Smooth muscle cell

C. Basket cage

D. Myoblast

E. Muscle fiber

6. Muscle tissue of mesenchymal origin is presented to the laboratory for research. What structure is the morphofunctional unit of such muscle tissue?

A. Muscle tube

B. Myocyte

C. Cardiomyocyte

D. Myoblast

E. Mion

7. A 38-year-old patient was admitted to the clinic with a diagnosis of spastic colitis - a disease accompanied by prolonged spasms of intestinal smooth muscles. Which of the following properties is not characteristic of smooth muscle contraction?

A. Slow

B. Tonic

C. Involuntary

D. Tetanic

E. Continuous

8. As a result of myocardial infarction, a part of the heart muscle was damaged with massive death of cardiomyocytes. What cellular elements will provide replacement of the formed defect in the structure of the myocardium?

A. Fibroblasts

B. Cardiomyocytes

C. Myosatellitocytes

D. Epithelial cells

E. Unstated myocytes

9. When examining injured cardiac muscle tissue, destruction of thick myofilaments is observed. In what part of the myophobril will pathological changes be localized when studying the fibers in polarized light?

A. In disk I

B. In disk A

C. In the telophragm

E. In disc A and in disc I

E. In half of disk I

10. When examining injured cardiac muscle tissue, destruction of thick myofilaments is observed. Which supporting structures connected to myosin filaments are also damaged?

A. Telophragm

B. Mesophragm

C. L-system

D. T-system

E. Cytolemma

11. In an experimental study of cardiac muscle tissue after the action of hydrolytic enzymes, the destruction of thin myofilaments is observed. What supramolecular structures have suffered damage?

A. Actin filaments

B. Myosin filaments

C. Tonofibrils

D. Tropocollagen complexes

E. Nucleoprotein complexes

12. On a histological preparation of the heart wall, the bulk of the myocardium is formed by cardiomyocytes, which, with the help of intercalated discs, form functional muscle fibers. What type of connections provide electrical connections to neighboring cells?

A. Slotted contact (nexus)

V. Desmosoma

C. Interdigitation

D. Close contact

E. Simple contact

13. During surgery, a part of the small intestine was removed from the patient. Due to what elements is muscle membrane regeneration possible?

A. Smooth myocytes

B. Adipocytes

C. Myosatellitocytes

D. Fibrocytes

E. Myosatelytocytes

14. As a result of transmural myocardial infarction, an area of the heart muscle tissue died. Name the source of reparative regeneration at the site of cardiomyocyte necrosis.

A. Cardiomyocytes

B. Myosatellitocytes

C. Myocytes

D. Myoblasts

E. Connective tissue

15. During ventricular systole, the myocardium does not receive arterial blood. What inclusions in cardiomyocytes provide them with oxygen?

A. Pigmented.

B. Trophic.

C. Excretory.

D. Secretory.

E. Endocrine.

16. During the systole of the ventricles, the myocardium does not receive arterial blood. What inclusions in cardiomyocytes provide them with oxygen?

A. Hemoglobin

B. Myoglobin

C. Glycogen

D. Lipofuscin

E. Melanin

17. In a conditional experiment, the mesenchymal cells were inhibited in the embryo. What kind of muscle tissue development is impaired?

A. Striated heart

B. Cross-striped skeletal

C. Smooth

D. Myoepithelial

E. Nevralnoy

18. In the laboratory of electron microscopy, differential diagnostics of different types of muscle tissue is carried out. Which of the following structural features is characteristic only of smooth muscle tissue?

A. Pinocytic vesicles and caveolae

B. Anastomoses

C. Insert Discs

D. Myosatellitocytes

E. T-system

19. In the laboratory of electron microscopy, differential diagnostics of different types of muscle tissue is carried out. Which of the following structural features is characteristic only of cardiac muscle tissue?

A. Pinocytic vesicles and caveolae

B. L-system

C. Insert Discs

D. Myosatellitocytes

E. T-system

20. Histological examination of the skin preparation revealed

myoepithelial cells. Which of the following signs is not typical for them?

A. Located in the glands of the skin

B. Are of mesenchymal origin

C. Star-shaped

D. Promote secretion of glands

E. They contain a contractile apparatus in the processes

METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

Minutes No. 2 of "26" September 2022.

Head of the department _____ (Tiron O.I.)

Developers:

Candidate of Medical Sciences, Associate Professor, Tiron O.I.

Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. General morphological and functional characteristics of the nervous tissue.

2. Common structural components of neurons.

3. Describe the structural components and localization of neurofibrils.

4. Describe the structural components and localization of the chromatophilic substance.

5. Name the main characteristic features of neurosecretory cells.

6. Morphological classification of neurons.

7. Name the functional classification of neurons.

8. Describe the morphological and functional characteristics of oligodendrocytes.

9. Describe the morphological and functional characteristics of ependymocytes.

10. Describe the morphological and functional characteristics of protoplasmic astrocytes.

11. Describe the morphological and functional characteristics of fibrous astrocytes.

12. Describe the morphological and functional characteristics of microglia cells.

Questions for individual work.

1. Axonal transport: types, functional significance.

2. The concept of reflex arcs and their neural composition.

3. Sources of development of neurocytes and gliocytes

4 The concept of neurotransmitters.

5. Secretory neurons.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. Electron microphotography shows a nerve cell with an abundance of organelles in the cytoplasm. What type of cell structures are neurofibrils?

2. During the experiment, the animal was damaged by nerve endings, achieving the loss of various types of sensitivity. What structure of a neuron is involved in conducting a nerve impulse?

3. In the process of embryonic development during the differentiation of cells of the nervous tissue, there is a change in the number of processes in neurocytes. Which of the following neurons are multipolar?

4. During the experiment, the transport of the mediator acetylcholine to the terminal part of the neurocyte process was revealed. Specify the type of cytoplasmic current in the neuron, with the help of which the mediator was moved?

5. In the course of the experiment, we studied the features of fast antegrade transport in neurocytes. What components are moved by fast transport?

6. During the experiment, the study of the features of retrograde transport in neurocytes was carried out. What components are moved by retrograde transport?

7. During the experiment, the cells of the nervous tissue, which are the descendants of the hematopoietic stem cell, belonging to the system of mononuclear phagocytes, were studied. What cells were studied?

Microslides

1. Chromatophilic substance in the neurons of the spinal cord. Nissl staining.

2. Neurofibrils in the neurocytes of the spinal cord. Silver impregnation.

Specimens for study

Specimen for examination 1. Chromatophilic substance in multipolar neurocytes of the spinal cord (Fig. 1).

Small magnification. At this magnification, find a large multipolar neuron colored blue.

High magnification. At this magnification, consider the large light nucleus of the neurocyte with an intensely stained nucleolus. In the cytoplasm, lumps of blue basophilic substance are located in the body and dendrites of neurons; the exception

is the axonal tubercle and axon. Draw and designate: 1) multipolar nerve cells: a - the nucleus with the nucleolus; b - axon;

c - dendrites; d - lumps of chromatophilic substance; 2) the nuclei of glial cells.

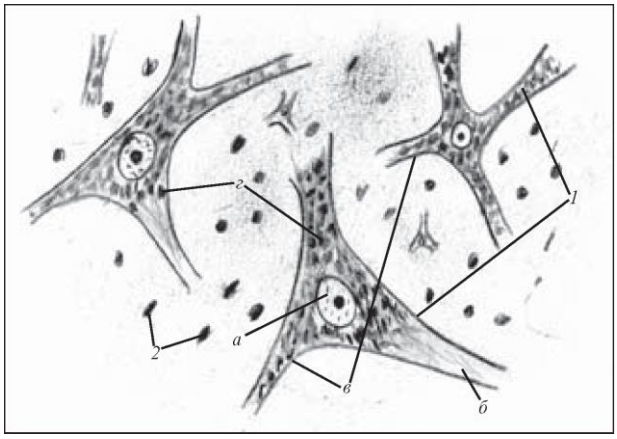


Figure: 1. Chromatophilic substance in multipolar neurocytes of the spinal cord. Nissl staining. × 400:

1- Multipolar nerve cells (a-nucleus with a nucleolus b - axon; c-dendrites; d - lumps of chromatophilic substance) 2 - nuclei of glial cells

Specimen for examination 2. Neurofibrils in neurocytes (Fig. 2).

Small magnification. With this magnification, find a large multi-cord neurocyte. High magnification. A bright nucleus with a well-visible brown or black nucleolus is visible. In the body of the neurocyte, neurofibrils (in the form of black or brown filaments) are clearly visible, which form a mesh, and in the processes they run parallel to each other. Neurofibrils are present in both dendrites and axons. Draw and designate: 1) neurocytes; 2) the nucleus of the neurocyte; 3) the nucleolus; 4) processes; 5) neurofibrils.

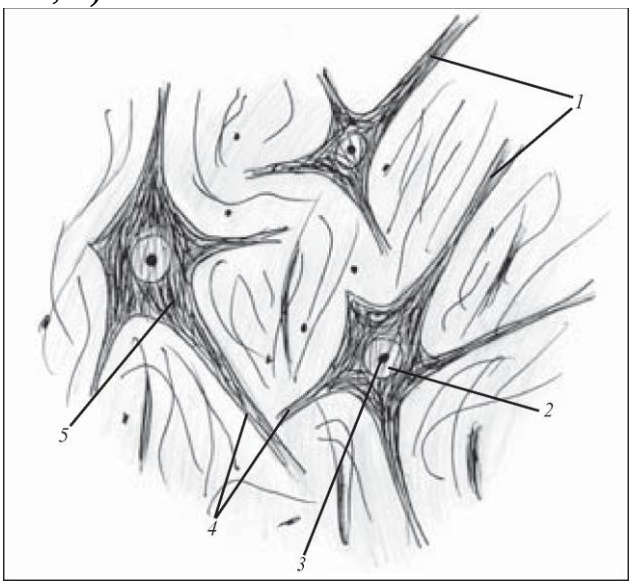


Figure: 2. Neurofibrils in neurocytes. Silver impregnation. × 600: 1 - neurocytes; 2 - the nucleus of the neurocyte; 3 - nucleolus; 4 - processes; 5 - neurofibrils

6.3. Control materials for the final stage of the lesson.

Test tasks

1. In children in the first year of life, convulsions easily occur, which can be associated with incomplete myelination of nerve fibers. Which neuroglial cells form the myelin sheath?

A. Oligodendrocytes

B. Ependymocytes

C. Fibrous astrocytes

D. Microglial cells

E. Protoplasmic astrocytes

2. Functional depletion of a neuron is accompanied by chromatolysis - the breakdown of the basophilic substance. What organelles form this substance?

A. Granular endoplasmic reticulum

B. Neurofibrils

C. Lysosomes

D. Golgi complex

E. Mitochondria

3. A histological examination of the nervous tissue revealed the presence of several types of neurocytes. All these neurons are designated according to the morphological classification, except for:

A. Associative

B. Unipolar

C. Bipolar

D. Multipolar

E. Pseudo-unipolar

4. On a histological specimen, nerve cells are visible, the cytoplasm of which is filled with lumps of basophilic colored substance - a chromatophilic substance. At the level of electron microscopy, it is presented:

A. Cisternae of the granular endoplasmic reticulum

B. Clusters of mitochondria

C. Clusters of free ribosomes

D. Golgi complex

E. Smooth endoplasmic reticulum

5. On a histological specimen of nervous tissue, neuroglial elements are present among numerous

neurocytes. Which of the following functions is not inherent in neuroglia?

A. Transmission of nerve impulses

B. Dividing

C. Support

D. Trophic

E. Secretory

6. The electron diffraction pattern shows process-shaped glial cells capable of amoeboid movements. Large processes have short secondary and tertiary branches on the surface. What type of gliocytes are these cellular elements?

A. Microgliocytes

B. Ependymocytes

C. Protoplasmic astrocytes

D. Fibrous astrocytes

E. Oligodendrocytes

7. In a patient admitted to the neurological department, loss of sensitivity is associated with damage to pseudo-unipolar neurons. Where are these neurons located?

A. Spinal ganglia

B. Spiral ganglion of the ear

C. Intramural vegetative ganglia

D. Retina

E. Thalamic tubercle

8. During the experiment, the localization of functionally and morphologically different nerve cells was determined. What is taken into account in the morphological classification of neurons?

A. Number of processes

B. Cell sizes

C. Cell body shape

D. Location of processes

E. Cell functions

9. The development of hypertensive-CSF syndrome is associated with impaired secretion and outflow of cerebrospinal fluid by ependymocytes. Where are ependymocytes located?

A. Lining the cavities of the central nervous system

B. In the gray matter of the brain

C. On the surface of the bodies of neurons

D. In the white matter of the brain

E. On the processes of neurons

10. The preparations show three neurocytes: pseudo-unipolar, bipolar and multipolar. How many axons can be identified in each of them?

A. One

At five

C. Two

D. Three

E. None

11. The diagram shows the cellular elements of neuroglia: cells of a cylindrical shape, which have cilia on the apical surface. What type of gliocytes are these cellular elements?

A. Ependymocytes

B. Astrocytes fibrous

C. Protoplasmic astrocytes

D. Microgliocytes

E. Oligodendrogliocytes

12. During the experiment, the animal was subjected to prolonged and excessive pain stimuli, which caused functional depletion of neurons. What structural changes will be observed in a cell when stained according to Nissl under a light microscope?

A. Disappearance of the basophilic substance

B. Dysfunction of synapses

C. Violation of membrane depolarization

D. Increase in the number of processes

E. Division of neurocyte

13. On a spinal cord specimen, two types of gliocytes with numerous processes are presented. The first type of gliocytes is localized in the gray matter, the second - in the white matter of the brain. What type of gliocytes is the first type of cells?

A. Protoplasmic astrocytes

B. Microgliocytes

C. Oligodendrogliocytes

D. Fibrous astrocytes

E. Ependymocytes

14. On a spinal cord specimen, two types of gliocytes with numerous processes are presented. The first type of gliocytes is localized in the gray matter, the second - in the white matter of the brain. What type of gliocytes is the second type of cells?

A. Fibrous astrocytes

B. Microgliocytes

C. Oligodendrogliocytes

D. Protoplasmic astrocytes

E. Ependymocytes

15. Electron microphotography shows a nerve cell with an abundance of organelles in the cytoplasm. What type of cell structures does the chromatophilic substance of a neuron belong to?

A. Organelles of the protein synthesizing apparatus

B. Lysosomes

C. Dictyosomes of the Golgi complex

D. Cytoskeleton

E. Mitochondria

METHODOLOGICAL DEVELOPMENT

practical training

in the discipline of histology, cytology and embryology

Faculty, medical course I course

Academic discipline histology, cytology and embryology

Approved:

The meeting of the Department of Histology, Cytology and Embryology of Odesa National Medical University

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Head of the department _____ (Tiron O.I.)

Developers:

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Candidate of Medical Sciences, Associate Professor Kuvshinova I.I.

Candidate of medical sciences, senior lecturer. Markova O.O.

st.excl. Lyashevska O.O.

6. Materials for methodological support of the lesson.

6.1. Control materials for the preparatory stage of the lesson

Control questions

1. General characteristics and classification of nerve fibers.

2. Comparative morphofunctional characteristics of myelinated and nonmyelinated nerve fibers.

3. Describe the regeneration of nerve fibers.

4. General morphological and functional characteristics of nerve endings.

5. What is the classification of nerve endings.

6. Comparative characteristics of receptor and effector nerve endings.

7. Describe the characteristic features of the structure of synapses.

8. Name and describe the classification, function and localization of synapses.

9. The mechanism of transmission of excitation in synapses.

10. Describe the structure of the reflex arc.

Questions for individual work.

1. Stages of regeneration of nerve fibers after damage.

2. The structure of the peripheral nerve. The concept of endo-, peri- and epineuria.

3. Features of the structure of the neuromuscular spindle.

4. The influence of environmental factors on the nervous tissue.

6.2. Materials for methodological support of the main stage of the lesson: situational tasks, description of preparations and electronic micrographs.

Situational tasks

1. Electron microscopy of a transverse section of a nerve fiber shows several axial cylinders located at the periphery of the neurolemmocyte. What are these nerve fibers?

2. With electron microscopy and a longitudinal section of the nerve fiber, it is possible to distinguish the interception of Ranvier, the axial cylinder, the mesaxon,

the cytoplasm of the oligodendrocyte. The basement membrane and myelin notches are missing. What is this nerve fiber?

3. Synapses are specialized intercellular contacts and provide polarization of the impulse conduction. Which of the processes is absent during synaptic transmission of a nerve impulse?

4. After traumatic injury of the limb, the tactile sensitivity of the skin was disturbed. Which cells in the epidermis of the skin, together with the terminals of afferent fibers, form tactile receptors?

Microslides

1. Myelinated nerve fibers. Osmic acid staining.

2. The lamellar body of Vater-Pacini. Hematoxylin-eosin staining.

3. Peripheral nerve. Cross section of the sciatic nerve. Hematoxylin-eosin staining.

Specimen for examination 1. Myelinated nerve fibers (Fig. 1).
Small magnification. Find the myelin fiber at this magnification.
Great magnification. A palely colored axial cylinder is clearly visible, along which there is a dark myelin layer with nodal interceptions and notches of myelin, which looks like oblique, narrow and light cracks. Neurolema is clearly visible in the area of the nodal interception. Draw and designate: 1) axial cylinder; 2) neurolema: a - myelin; b - nodal interception; c - neurolema.

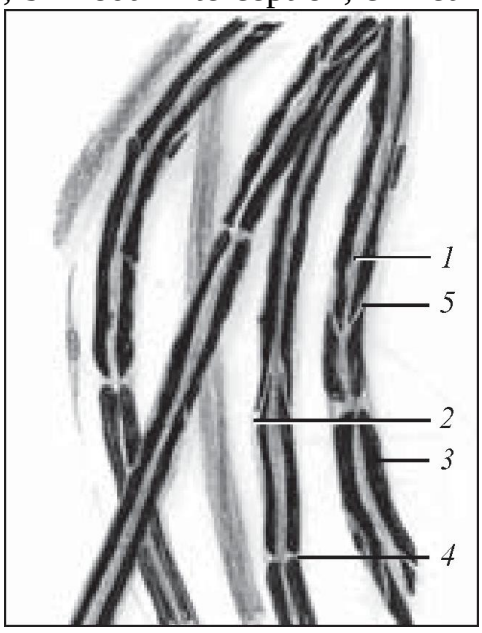


Figure: 1. Myelinated nerve fibers. Osmic acid staining: objective - × 40, eyepiece - × 15:

1 - axial cylinder; 2 - neurolema; 3 - myelin; 4 - nodal interception; 5 - neurolema

Specimen for examination 2. Encapsulated nerve ending. Fater's Pacini body - (fig. 2).

Small magnification. Find the encapsulated nerve ending, which consists of inner and outer flasks, is large, round, and the capsule is spherical. In the center of the calf, a pale colored inner flask is visible. Draw and designate: 1) the end sections of the gland; 2) a longitudinal section of the lamellar body: a) the plates of the outer flask; b) an inner flask; 3) cross section of the lamellar body; 4) nerve fibers that fit the lamellar body.

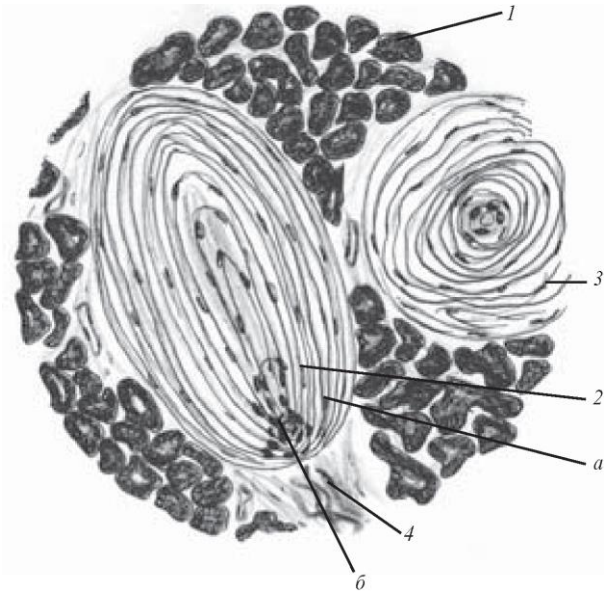


Figure: 2. Encapsulated nerve ending. Fater's Pacini body -. Hematoxylin-eosin staining. × 120:

1 - end sections of the pancreas; 2 - longitudinal section of the lamellar body (a-plates of the outer flask b - inner flask) 3 - cross-section of the lamellar body; 4 - nerve fibers that fit the lamellar body

Specimen for examination 3. Peripheral nerve. Transverse section of the sciatic nerve (Fig. 3).

Small magnification. Myelin fibers have the appearance of light circles with a dark central point. Connective tissue looks like pink cords with purple connective tissue nuclei. It forms three types of layers: endoneurium - inside the bundle of nerve fibers, perineurium - around the bundle of nerve fibers, epineurium - around the entire nerve.

Draw and designate: 1) myelinated nerve fibers; 2) endoneurium; 3) perineurium; 4) epineurium; 5) blood vessels; 6) fat cells.

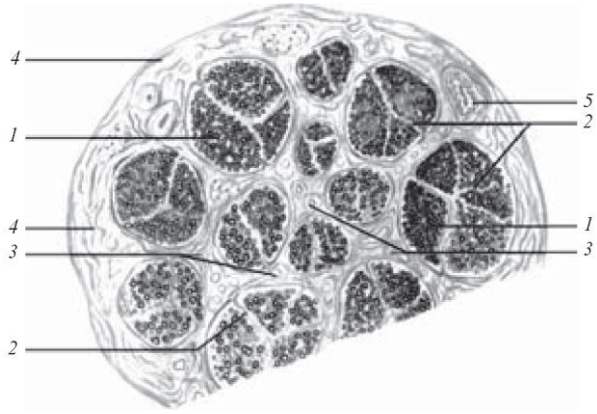


Figure: 3. Peripheral nerve. Cross section of the sciatic nerve. Hematoxylin-eosin staining. × 120:
1 - myelin nerve fibers; 2 - endoneurium; 3 - perineurium; 4 - epineurium; 5 - blood vessels

Electron micrographs

1. Sensitive encapsulated nerve ending.

2. Non-myelinated nerve fibers.

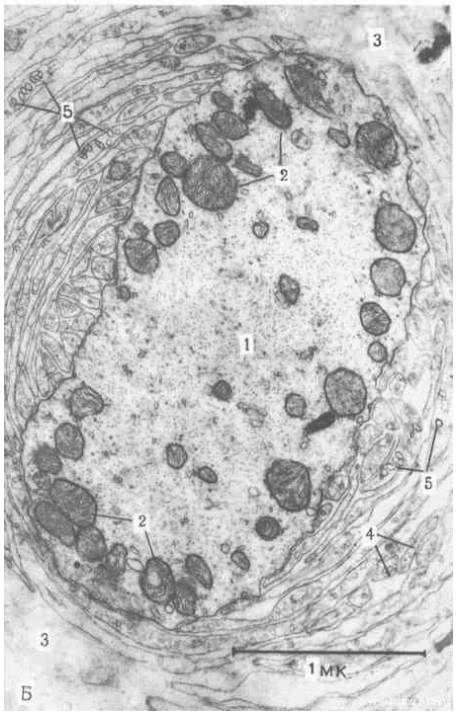
3. Myelinated nerve fibers.

4. Motor nerve ending.

5. Interception of Ranvier.

Sensory encapsulated nerve ending (Pacinian corpuscle)

Lamellar (Pacinian) corpuscle. Electronic microphotogram.



1 – dendrite; 2 - mitochondria; 3 – cavity of inner bulb; 4 – processes of lamellar cells of the inner bulb; 5 – pinocytic vesicles.

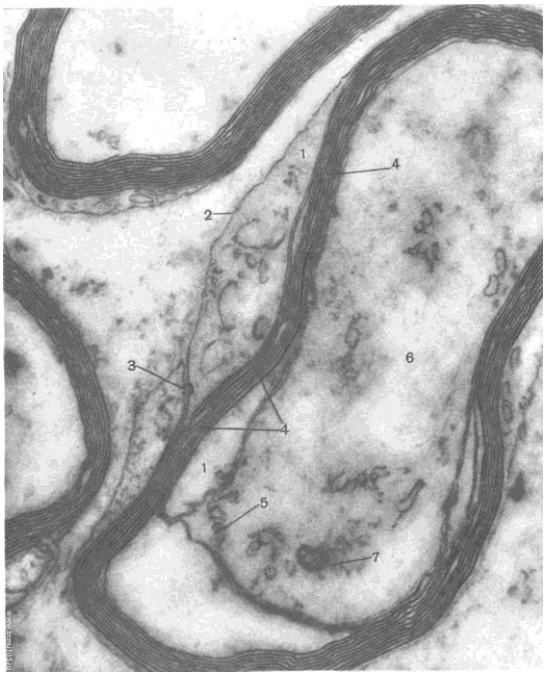
Unmyelinated nerve fibers

Unmyelinated nerve. Cross section. Electronic microphotogram. × 17 000

1 – axial cylinder of unmyelinated nerve fiber; 2 – nucleus of neurolemmocyte (Schwann cell); 3 - mesaxon; 4 – cross sections of collagen protofibrils of endoneurium.

Myelinated nerve fibers

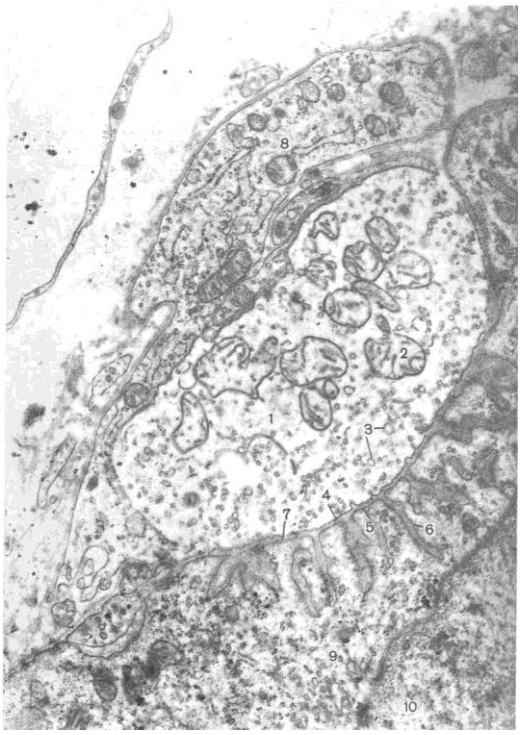
Myelinated nerve fiber. Electronic microphotogram of the cross section of myelinated nerve fiber of frog sciatic nerve. × 65 000



1 – cytoplasm of neurolemmocyte (Schwann cell); 2 – cell membrane of neurolemmocyte; 3 - mesaxon; 4 – mesaxon turns; 5 - axolemma; 6 - axoplasm; 7 - mitochondrion.

Motor nerve ending

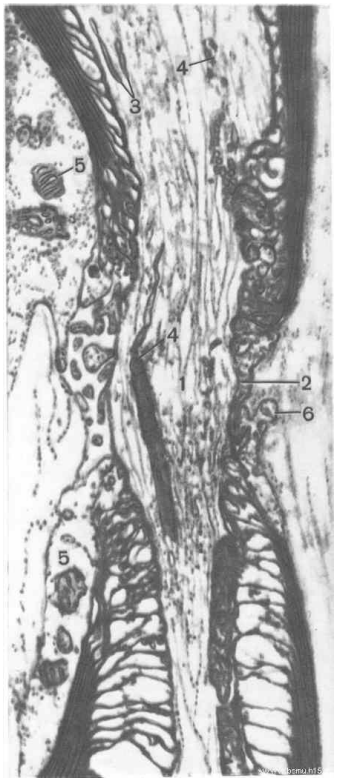
Motor nerve ending. Electronic microphotogram. × 33 000



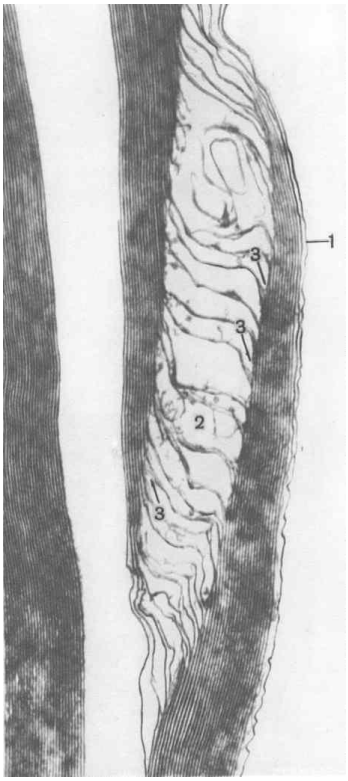
1 – terminal branches of nerve fiber; 2 – mitochondria in the axoplasm; 3 – synaptic vesicles in the axoplasm; 4 – axolemma forming presynaptic membrane at this point; 5 – sarcolemma forming postsynaptic membrane at this point; 6 – folds of postsynaptic membrane; 7 – synaptic cleft; 8 - neurolemmocyte (Schwann cell); 9 – sarcoplasm; 10 – nucleus of muscle fiber.

The node of Ranvier of myelinated fiber (A) and myelin incisures of myelinated fiber (B)

A. The node of Ranvier in the myelinated fiber of sciatic nerve. Electronic microphotogram. × 7000



B. The structure of mesaxon in the area of myelin incisures (Schmidt-Lanterman clefts). Electronic microphotogram. Longitudinal section of the lateral part of myelinated nerve fiber of the sciatic nerve. × 65 000



A 1 – axial cylinder; 2 - axolemma; 3 – endoplasmic reticulum in the axoplasm; 4 – mitochondria in the axoplasm; 5 – mitochondria of neurolemmocytes (Schwann cells); 6 – finger-like invaginations of two neurolemmocytes in the area of their contact.

B 1 - axolemma; 2 – cytoplasm of neurolemmocyte, enclosed between two layers of its cell membrane in myelin incisures; 3 – depression of the mesaxon in the area of myelin incisures.

6.3. Control materials for the final stage of the lesson.

Test tasks

1. As a result of the action of a neurotropic toxic substance, the mechanism of transmission of a nerve impulse is disrupted. What structure provides this function?

A. Neuroplasm

B. Synapse

C. Neurofibrils

D. Mitochondria

E. Nissl's substance

2. After traumatic compression of a limb, degeneration of nerve fibers was found in its nerve trunk. What morphological features are absent in this case?

A. Destruction of myelin

B. Disintegration of nerve fiber endings

C. Degeneration of axial cylinders in the distal segment

D. Death of Schwann cells in the distal segment

E. Phagocytosis of fragments of damaged nerve fibers

3. A rough connective tissue scar appeared at the site of the nerve fiber transection. How will this affect the process of nerve fiber regeneration?

A. The regeneration process will slow down

B. The regeneration process will accelerate

C. Amputation neuroma will develop

D. Will not affect in any way

E. Myelination will be impaired

4. In the experiment, the sensitive nerve fibers that go to the skin were cut. What morphofunctional changes in the skin will not be observed in this case?

A. Loss of temperature sensitivity

B. Disorganization of receptor structures of the skin

C. Loss of pain sensitivity

D. Loss of tactile sensitivity

E. Violation of the keratinization process

5. In the preparation of the skin impregnated with silver salts, thin branching terminals of the afferent fiber were found, lying among the cellular elements of the epidermis in the form of a “bush”. What is the name of such a nerve ending according to the morphological classification?

A. Free

B. Non-free non-encapsulated

C. Nonfree encapsulated

D. Motor

E. Synapse

6. In a preparation of skeletal muscle tissue impregnated with silver salts, bundles of myelin fibers were found, which disintegrate into separate fibers and form synapses with muscle fibers in the form of plaques. Name this nerve ending.

A. Neuromuscular spindle

B. Free

C. Encapsulated

D. Motor

E. Interneuronal synapse

7. A nerve ending was found in the preparation of the pancreas. Its central part is occupied by a glial bulb, along the entire length of which a sensitive nerve terminal runs. Part of the myelin fiber and the entire inner bulb are surrounded by a thick multilayer connective tissue capsule. Name the receptor.

A. Taurus Ruffini

B. Merkel Meniscus

C. Krause flask

D. Meissner's body

E. Fater-Pacini corpuscle

8. Nerve fibers with a speed of transmission of a nerve impulse of 95 m / s were studied. What type are they?

A. Bezmyelinovye

B. Myelinated

C. Efferent

D. Afferent

E. Cable

9. Nerve fibers with a speed of transmission of a nerve impulse of 1.5 m / s were studied. What type are they?

A. Bezmyelinovye

B. Afferent

C. Efferent

D. Myelinated

E. Intrafusal

10. Examination of skeletal muscle tissue revealed a formation containing several intrafusal muscle fibers with a nuclear bursa and a nuclear chain, surrounded by a thin a fusiform capsule. Name the receptor.

A. Free nerve ending

B. Neuromuscular spindle

C. Fater-Pacini corpuscle

D. Krause flask

E. Meissner's body

11. The nerve fiber is cut. Clavate extensions of the axial cylinder (growth flasks) were found on the specimen. What section of nerve fiber does the area under study belong to?

A. To the central

B. To peripheral

C. Towards intermediate

D. To degenerating

E. To presynaptic

12. Regeneration of the peripheral nerve after traumatic rupture is accompanied by a number of morphological processes. What processes are not typical?

A. Reproduction of neurocytes

B. Destruction of axial cylinders and disintegration of myelin throughout the peripheral segment

C. Degeneration of nerve fibers over a short length of the central segment

D. Germination of axons from the central segment to the peripheral

E. Orientation of regenerating axons along Schwann cell chains

13. Myelinated nerve fiber consists of an axial cylinder surrounded by a myelin sheath. What is the formation of the myelin layer of the peripheral nerve fiber?

A. Compacted intercellular substance containing proteins and phospholipids

B. Plasma membrane of Schwann cells

C. A specialized part of the perineurium

D. Elements of the cytoskeleton of Schwann cells

E. Spirally coiled axon membrane

14. After traumatic compression of the limb, temperature sensitivity disappeared. Which sensitive nerve endings have lost contact with the central analyzer?

A. Free nerve endings

B. Ruffini's bodies

C. Lamellar bodies of Pacini

D. Meissner's tactile bodies

E. Golgi tendon organs

15. A patient with intoxication neuritis has impaired conduction of a nerve impulse in the neuromuscular synapses, which leads to muscle weakness. What nerve endings have undergone a pathological process?

A. Tendon spindles

B. Muscle spindles

C. Motor plaques

D. Pacini Taurus

E. Taurus Ruffini

The main one:

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3. Histology and embryology of internal organs: textbook / E.F. Barinov, Y.B. Tchaikovsky, O.M. Sulaeva et al.
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