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# Adaptation and regeneration processes. Adaptive changes: species, morphological characteristics, clinical significance. Hyperplasia. Hypertrophy. Atrophy. Metaplasia. Dysplasia. Healing wounds. Scar morphogenesis.

1. Purpose: to study the structural aspects of the processes of regeneration and adaptation in various organs and tissues.
2. Requirements for the level of the student for mastering the discipline - pathological anatomy.
3. The student must know:
1. Definition of the concepts "hypertrophy" and "hyperplasia". The mechanisms of increasing the organ and tissue in volume. Stages of the hypertrophic process.
3. Types, outcomes of hypertrophy, causes and mechanisms of their development.
3. Stages of compensatory and adaptive processes.
4. Differences between compensation and adaptation.
5. Definition of the concepts of "regeneration" and "metaplasia".
6. Types of regeneration, mechanisms of their development.
7. Definition of the concept of "regenerative hypertrophy".
8. Healing of wounds, types and mechanisms of development of the process.
9. Definition of the concept of "organization", types of organization.
10. Structure and function of granulation tissue.
11. Regeneration of certain types of tissues.
12. The importance of organization for the body.

Theoretical aspects:
The adaptation process is a general, generalized, stage-by-stage reaction of the body. The main biological significance of the adaptation process is the adaptation of the organism to changes in the external or internal environment.
The adaptation process is the general reaction of the body to the action of an external or internal environment factor that is unusual for it. This reaction is characterized by staged specific and nonspecific changes in vital activity: as a rule, it provides an increase in the body's resistance to the factor affecting it and, as a consequence, its adaptability to changing conditions of existence.
For the first time, the concept of the adaptation process (syndrome) was formulated by the pathoologist G. Selye in 1935-1936. Selye singled out its general and local forms.
TYPES OF THE ADAPTATION PROCESS
The general (generalized, systemic) adaptation process is characterized by the involvement of all or most of the organs and physiological systems of the body.
The local adaptation process is observed in individual tissues or organs during their alteration, occurs with local tissue damage, the development of inflammation, tumors, allergic reactions and other local pathological processes in them. However, the local adaptation process is formed with more or less participation of the whole organism.
The adaptive process develops against the background of an orienting reaction of the body, activation of a nonspecific, as well as a specific response to a causal factor. Subsequently, temporary connections and functional systems are formed that provide the body with either “escape” from the acting emergency agent, or overcoming its pathogenic effects, or an optimal level of vital activity, despite the continuing influence of this agent, i.e. adaptation itself.
The first stage of the adaptation process - the stage of urgent (emergency) adaptation - is to mobilize the compensatory, protective and adaptive mechanisms that pre-exist in the body. This is manifested by a triad of natural changes.
The second stage of the adaptation process - the stage of increased stable resistance, or long-term adaptation of the organism to the action of an extraordinary factor - is implemented as follows.
The third stage of the adaptation process is referred to as the stage of exhaustion, or wear and tear. This
the stage of the adaptation process (at this stage it is more often referred to as "adaptation syndrome") is not mandatory. It is realized only when the causal factor of the adaptation process becomes pathogenic, and its action is not eliminated. In most cases, the adaptation process ends

with the formation of a long-term increased resistance of the organism to an emergency factor acting on it.
With the development of this stage, the processes underlying it can cause the development of diseases, pathological conditions, and even the death of the organism. The latter is most likely with repeated, especially multiple, development of the adaptation process, with the termination and subsequent action after a certain period of time of the same or another emergency factor. So, when adapting to significant physical exertion, hypoxia, cold and other factors, significant structural changes develop in organs and tissues (neurons of various nerve centers are hypertrophied in the brain; the mass of the cortex and medulla of the adrenal glands, thyroid tissue and some other endocrine glands; the myocardium, certain groups of skeletal muscles, and especially the cells of organs and tissues involved in the implementation of the process of specific adaptation to this factor, are hypertrophied).
The repeated development of the adaptation process can lead to the "wear" of systems that provide specific adaptation to this, and often to other factors. The latter is observed in the elderly or after severe chronic diseases, since the capabilities of the systems of energy and plastic support for the processes of synthesis and destruction of structures, the reparation of nucleic acids and proteins under these conditions are significantly reduced.
This can contribute to the emergence of conditions referred to as diseases of adaptation (more precisely, its violation) - dysadaptation (for example, hypertension, peptic ulcer, endocrinopathy, neurotic conditions, immunopathological reactions, etc.).

**REGENERATION**

Regeneration is the restoration by the body of lost or damaged tissues, cells, intracellular structures either as a result of their physiological death, or as a result of pathological effects. In accordance with this, the restoration of all elements of living matter that perish in the process of life activity is physiological regeneration, and the restoration of what is lost as a result of pathological processes is reparative regeneration.
Restitution. After damage, tissue identical to the lost tissue can be restored, and this regeneration is called restitution.
Substitution. If a connective tissue scar forms at the site of injury, they speak of substitution.
Pathological regeneration. Regeneration can also be pathological, when the function of the regenerating tissue is not restored or is perverted. Distinguish between hyperregeneration, hyporegeneration and metaplasia.
Hyporegeneration. The restoration of lost tissues can go very slowly, and then hyporegeneration takes place (for example, with trophic ulcers).
Hyper-regeneration. Sometimes the tissue regenerates excessively, which sometimes not only does not restore the function, but vice versa - the function of the organ suffers. In this case, we are talking about hyper-regeneration (for example, a keloid scar).
Metaplasia. Metaplasia should also be attributed to pathological regeneration - the transition of one type of tissue to another, but histogenetically related to it.
An example of metaplasia is the development in the area of damage to the bronchial mucosa instead of the ciliated epithelium of the stratified squamous epithelium, or the transformation of connective tissue into bone. With metaplasia, the function of the lost tissue is not restored.

**Lesson plan.**

Explore and describe:

Mandatory **macropreparations**:

1. To study the atrophy of the brain according to the macroscopic picture. Describe the size, shape of the brain when studying the drug "Hydrocephalus".

2. To study cardiac hypertrophy according to the macroscopic picture. Describe the drug "Hypertrophy of the left ventricular myocardium in hypertension", pay attention to the size of the organ, the size of the wall of the atria and ventricles, the size of the cavities, the consistency and color of the myocardium.

3. To study kidney atrophy according to the macroscopic picture. Describe the "Shriveled kidney" macro-preparation. Pay attention to the size, color and consistency of the organ.

4. To study kidney atrophy according to the macroscopic picture. Describe the "Hydronephrosis" macro-preparation. Pay attention to the size, color and consistency of the organ, size and lining of the cavities.

**Micropreparations**

1. To study heart hypertrophy by microscopic picture. Describe the micropreparation "Myocardial hypertrophy", pay attention to the fact that muscle fibers are much thicker compared to normal ones, their nuclei are large, hyperchromic. Each muscle fiber is separated from the adjacent one by a wider layer of connective tissue than normal.

2. Examine the granulation tissue by a microscopic picture. Describe the micropreparation "Granulation tissue". A significant defect is filled with young connective tissue rich in capillary vessels. The upper granulation layer is rich in segmented leukocytes. The layer is covered with fibrinous masses with epithelial residues. Undifferentiated connective tissue cells predominate in the middle layer. Differentiated cells appear in the lower parts: histiocytes, fibroblasts, fibrillogenesis phenomena are noted.

3. To study the hypertrophy of hepatocytes in cirrhosis. Describe the micropreparation "Regenerative hypertrophy of hepatocytes in cirrhosis", pay attention to the fact that structural reorganization is noted in the liver tissue, expressed in the formation of "false" hepatic lobules surrounded by connective tissue. The structure of the lobule is changed - there are no hepatic tracts, the central vein is absent or is located eccentrically. Some of the hepatocytes in the newly formed "false" hepatic lobules are hypertrophied.

4. To study large-focal cardiosclerosis by microscopic picture. Describe the micropreparation "Cardiosclerosis", pay attention to the difference in the color of muscle and connective tissue, the size of muscle cells around the scar, the size and hyperchromia of the nuclei.

5. Examines the metaplasia of the simple epithelium into the stratified squamous epithelium. Describe the micropreparation "Metaplasia of the glandular epithelium of the bronchus in the flat", pay attention to the state of the epithelium of the mucous membrane.

**Questions**.

1. REPLACEMENT OF LOST TISSUE ELEMENTS BY CELLS OF THE SAME TYPE IS CALLED
1) scarring
2) regeneration
3) hyperplasia
4) fibroplasia
5) hypertrophy

2. SUBSTITUTION OF A DEFECT WITH A MATURE CONNECTING TISSUE IS CALLED
1) scarring
2) hyperplasia
3) fibroplasia
4) hypertrophy

3. MECHANISMS OF TISSUE RECOVERY INCLUDE PROCESSES
1) promotion
2) migrations
3) inflammation
4) proliferation
5) thrombus formation

4. FOR CORRECT REGENERATION OF THE EPITHELIUM IS REQUIRED TO BE PRESENT
1) innervation
2) basement membrane
3) blood vessels
4) apudocytic differons

5. FAVORABLE OUTCOME OF MYOCARDIAL INFARCTION
1) regeneration
2) scarring

6. INCREASE IN TISSUE CELLS
1) atrophy
2) dystrophy
3) hyperplasia
4) hypertrophy

7. INCREASE IN TISSUE CELL VOLUME
1) atrophy
2) dystrophy
3) hyperplasia
4) hypertrophy

8. HYPERPLASIA IS
1) atrophic
2) pathological
3) dystrophic
4) physiological
5) metaplastic

9.When the wounds heal, they will proliferate in the connective tissue

1) melanocytes
2) fibroblasts
3) keratinocytes
4) endothelial cells

10. IN THE HEART WITH ARTERIAL HYPERTENSION, PREVENTLY HYPERTROFED
1) right atrium
2) the right ventricle
3) left ventricle
4) left atrium
Отправить отзыв
История
Сохраненные

11. POSSIBLE CONNECTIVE TISSUE METAPLASIA IN
1) bone
2) nervous
3) renal
4) cartilaginous
5) hepatic

12. METAPLASIA OF THE BRONCH EPITHELIA DEVELOPS IN THE BACKGROUND
1) plethora
2) inflammation
3) lymphostasis
4) dysplasia

13. ON THE BACKGROUND OF METAPLASIA, BRONCH EPITHELIUM CAN DEVELOP
1) cancer
2) necrosis
3) dystrophy
4) amyloidosis
5) inflammation

14. AT THE DISCOVERY OF THE BODY OF A PATIENT DIE OF CACHEXIA, FOUND
1) nutmeg liver
2) sago spleen
3) sebaceous spleen
4) brown heart atrophy
5) brown liver atrophy
6) brown induration of the lungs

15. METAPLASIA CAN BE EXPOSED TO TISSUE
1) nervous
2) muscular
3) vascular
4) epithelial
5) connecting

16. IN CACHEKSIA LIVER SIZES
1) reduced
2) not changed

3) increased

17. OUTCOMES OF IRON HYPERPLASIA ENDOMETRY
1) malignancy
2) reverse development
3) endometrial atrophy
4) endometrial metaplasia

**Tasks for independent solution.**
No.1. The patient underwent resection of 1/3 of the liver due to trauma. After 10 years, he died of myocardial infarction.
1. What changes can be found in the site of liver resection and in the rest of it? 2. What is the pathological process and what kind of this process?

No. 2. The patient had one kidney removed due to injury.
1. What changes will occur in the remaining kidney? 2. What process do they relate to? 3. What will be the size of the remaining kidney?

No. 3. In a track and field athlete, the left ventricular muscle of the heart is 1.5 cm, the cavities are not enlarged.
1. What is this process called? 2. What phase of development does it belong to?

No. 4. A patient with an injury to the muscles of the thigh has a bone plate in the fascia.
1. What is this process called? 2. How can it end?

**List of recommended literature:**
**Basic literature:**

1. "Basic pathology" Vinay Kumar, Ramzi S. Cotran, Stanley L. Robbins, 1997.

**Additional literature:**

1. "Pathology. Quick Review and MCQs" Harsh Mohan, 2004.
2. "Textbook of Pathology " Harsh Mohan, 2002.
3. "General and Systemic Pathology" Joseph Hunter, 2002.
4. "General and Systematic Pathology " Ed. J.C.E. Underwood – Edinburgh: Churchill Livingstone, 1996 ($2^{th}$).
5. "Histology for Pathologist" Ed. S.S.Sternberg – Philadelphia: Lippincott Raven Publ, 1997 ($2^{th}$).
6. "Histopathology. A Color Atlas and Textbook" Damjanov I., McCue P.A. – Baltimore, Philadelphia, London, Paris etc.: Williams and Wilkins, A Waverly Co., 1996.
7. "Muir's Textbook of Pathology" Eds. R.N.M. MacSween, K. Whaley London: ELBS, 1994 ($14^{th}$).
8. "Pathology" Eds. Rubin, J.L. Farber – Philadelphia: Lippincott Raven Publ, 1998 ($3^{th}$).
9. "Pathology Illustrated" Govan A.D.T., Macfarlane P.S., Callander R. – Edinburgh: Churchill Livingstone, 1995 ($4^{th}$).
10. "Robbins Pathologic Basic of Disease" Eds. R.S.Cotran, V.Kumar, T.Collins – Philadelphia, London, Toronto, Montreal, Sydney, Tokyo: W.B.Saunders Co., 1998 ($6^{th}$).

11. “Wheater’s Basic Histopathology. A Color Atlas and Text” Burkitt H.G., Stevens A.J.S.L., Young B. – Edinburgh: Churchill Livingstone, 1996 (3th).
12. “Color Atlas of Anatomical Pathology” Cooke R.A., Steward B. – Edinburgh: Churchill Livingstone, 1995 (10th).
13. “General Pathology ” Walter J.B., Talbot I.C. – Edinburgh: Churchill Livingstone, 1996 (7th).
14. “Concise Pathology” Parakrama Chandrasoma, Glive R. Taylor.
15. “Pathology” Virginia A. LiVolsi, Maria J. Merino, John S. J. Brooks, Scott H. Saul, John E. Tomaszewski, 1994.
16. “Short lectures on pathology” Zagoroulko A., 2002
17. “Robbins pathologic basis of diseases” Cotran R., Kumar V., Collins T.
18. “General pathology” Dr. Fatma Hafez, 1979.
19. “Anderson’s Pathology ” Damjanov I., Linder J. – St. Louis: Mosby Inc., 1995 (10th).

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https://volgmu-pat-anat.3dn.ru/
https://webpath.med.utah.edu/