Список литературы

1. Nebesna Z.M., Hotiur O.I. Strukturno-funktsionktsionalni osoblyvosti krovonosnykh sudyn i hemodynamiky yaiechka u cholovikiv riznoho viku. Svit medytsyny ta biolohii. 2017, №1 (59), ss. 133–136. [in Ukrainian]
2. Pastukhova V.A. Morfolohichne doslidzhennia spermatohenezu u statevozrilykh shchuriv. Visnyk problem biolohii i medytsyny. 2011, T. 2, Vyp. 3, C. 145–146. [in Ukrainian]
3. Sarkysov D. S., Perova Yu. L. Mykroskopycheskaia tekhnyka. – M. : Medytsyna, 1996. – 362 s. [in Russian]
4. Spaska A. M. Histostruktura ta krovopostachannia yaiechka shchura, v normi, Visnyk morfolohii, 2011, T. 17, № 1, S. 73–76. [in Ukrainian]
5. Voloshyna I.S. Suchasni uiavlennia pro morfohenez vnutrishnikh orhaniv cholovichoi statevoi systemy pid diieiu riznykh faktoriv, Ukrainskyi morfolohichnyi almanakh. 2011, Tom 9, № 4, S. 155–160 [in Ukrainian]

Реферати

СУБМИКРОСКОПИЧЕСКАЯ ОРГАНИЗАЦИЯ СТРУКТУРНЫХ КОМПОНЕНТОВ СЕМЕННИКОВ ИНТАКТНЫХ БЕЛЫХ КРЫС

Волков К. С. , Муха С. Ю.

Проведены детальные электронномикроскопические исследования структурных компонентов семенников лабораторных белых крыс. Описаны особенности тонкого строения стромы, клеток Лейдига, гемокапилляров, стенки извитых семенных канальцев, поддерживающих и сперматогенных клеток в разные фазы сперматогенеза. Охарактеризованы структуры, которые входять в состав гематотестикулярного барьера.

Ключевые слова: семенники, электронномикроскопическая организация, белые крысы.

Стаття надійшла 8.05.18р.

SUBMICROSCOPIC ORGANIZATION OF STRUCTURAL COMPONENTS OF THE TESTIS OF INTACT WHITE RATS

K.S. Volkov, S.U. Mukha

Detailed electronmicroscopic studies of the structural components of the testis of laboratory white rats have been carried out. Features of the thin structure of the stroma, Leydig cells, hemocapillaries, walls of the convoluted seminiferous tubules, supporting and spermatogenic cells in different phases of spermatogenesis are described. Characterized structures that are a part of the blood-testis barrier.

Key words: testis, electronmicroscopic organization, white rats.

Рецензент Єрошенко Г.А.

DOI 10.26724 / 2079-8334-2018-2-64-138-142
UDC 616.155.394.5-002.43-06:616.314.18-002.4-022.7]-092.9

A. Ye. Demkovych
I. Horbachevsky Ternopil State Medical University, Ternopil, Ukraine

THE ROLE OF NECROTIC AND APOPTOTIC CHANGES IN NEUTROPHILIC GRANULOCYTES IN THE DEVELOPMENT OF EXPERIMENTAL BACTERIAL-IMMUNE PERIODONTITIS

E-mail: demkovushae@tdmu.edu.ua

Mechanisms of the inflammatory process development in the periodontal complex include a number of complicated processes leading to the generalization and chronicization, tooth loss and the appearance of complications from other organs. One of the key links in the immune system is cellular nonspecific immunity, which is not only instrument of an antiinfectious protection, but also a universal homeostasis effector. The article presents the results of studies of early and late apoptosis parameters of blood neutrophils on the 7^{th} and 30^{th} days of inflammatory process in periodontal tissues. The results were presented in percent (the ratio of the number of annexin-positive cells to the total number of neutrophil fraction) and were statistically processed using parametric and nonparametric methods of statistics. In this investigation a characteristic dynamics of changes in the number of cell death was revealed for formation of an inflammatory site in the periodontal complex. It is important to compare the results of the realization of necrosis and apoptosis of blood neutrophils in the experimental bacterial-immune periodontitis. In particular, the course of experimental periodontitis was accompanied by an increase in the content of annexin-positive (early apoptosis) and necrotic neutrophils, which is associated with increased intensity of their formation in response to antigen stimulation. In this modeled pathology, the realization of induced cell death occurred predominantly by apoptosis.

Key words: Periodontal complex, inflammation, neutrophils, apoptosis, necrosis.

This work is an part of RSW "Systemic and organic violations due to the actions of extraordinary factors on the body, mechanisms of their development and pathogenetic correction" (registration number 0116 U003390) and research work of the department of Prosthetic Dentistry: "Pathogenetic approaches to treatment the main dental diseases on the basis of studying the mechanisms of damage of the oral cavity tissues against the background of accompanying somatic pathology "(state registration number 0116 U005076).

Diseases of periodontal tissues is one of the important problems of theoretical and practical medicine [8]. Among them, the most currency has periodontitis, in particular its generalized form, in which inflammatory-dystrophic processes envelop all tissues of the periodontal complex [10, 16]. The etiology and pathogenesis of periodontal diseases are complicated and insufficiently studied, however, main role is given to infectious factor and ability of immune defense mechanisms (local cellular unspecific and general adaptive) to form an adequate character of the development and course of the

pathological process in the oral cavity, on which depend efficiency of treatment influences and prophylaxes methods [7]. It's remained unclear as well as the mechanisms due to which different by nature and character of action the local and general factors lead to inflammatory and destructive lesions of periodontal tissues [22]. The investigation of the mechanisms inflammatory processes in the tissues of the periodontal complex is one of the important problems of modern dentistry due to the relatively high wide spread and unfavourable prognosis, because frequency of periodontal disease in the all world oscillate within 5-20% and increases with age to 75% [3, 12]. Perfectining of the known and elaboration of new methods of periodontitis treatment is one of the important tasks and requires extraordinary approaches to their solutions. The ascertainsion of the character of immunological processes disorders will permit to establish the role of one the important links to damage of the periodontal complex and formation of an inflammatory process development of various degrees [19]. The immune response to oral microorganisms in inflammatory processes of periodontal tissues is realized unstandard way, in particular, of decreased bactericidal potential of the blood neutrophils, polyclonal activity of B-lymphocytes, high level of antibacterial antibodies and T-lymphocyte dysfunction, chronic inflammatory process with periodontal and bone tissue destruction [13, 14]. For all that, is carried out growing of granulations, that reflects disorder of proliferative processes, imbalance of cytokines production, apoptosis and development of hypoergic type inflammation [4, 6].

Purpose of this study was to determine the levels of apoptotic and necrotic changed blood neutrophils in the dynamics of experimental bacterial-immune periodontitis development.

Materials and methods. The investigation was performed with use of white, clinically healthy rats weighing 150-200 g in vivarium conditions. Animals were on a standard diet, balanced by nutritional elements. The experiments were carried out in compliance with the general rules and provisions of the European Convention for the Protection of Vertebrates used for research and other scientific purposes (Strasbourg, 1986), the general ethical principles of animal experiments (Kiev, 2001). The animals were divided into 3 groups: I – intact animals (n = 10); II – animals with experimental periodontitis on the 7^{th} day of the study (n = 8); III – animals with experimental periodontitis on the 30^{th} day of the study (n = 8).

Experimental bacterial-immune periodontitis in experimental animals was caused by injection into the periodontal complex tissue of microorganisms mixture diluted with egg protein [1]. To enhance the immune response, a complete Freund's adjuvant was injected into the rat's paw at the same time. When studies were performed with animals of group III on the 14^{th} day, repeated introduction of the pathogen and adjuvant were carried out. The experimental animals were sacrificed by bleeding under thiopental anesthesia on the 7^{th} and 30^{th} day. For further studies, the blood of the experimental animals was selected, with which neutrophils were isolated by gradient centrifugation [17]. FITC-labeled annexin V from the ANNEXIN V FITC reagent kit (Beckman Coulter, USA) was used to evaluate apoptosis and necrosis of neutrophils using flow cytofluorometry [18]. The results were presented in percent (the ratio of the number of annexin-positive cells to the total number of neutrophil fraction). The results were statistically processed using parametric and nonparametric statistical methods using the Excel software ("Microsoft", USA) and "STATISTICA" 10.0 (Statsoft, USA) [5]. The reliability of the differences in the values between independent quantitative values was determined with a normal distribution according to the Mann-Whitney U criterion [9].

Results of the study and their discussion. The mechanisms of inflammatory process formation in the periodontal tissues include a number of complicated links, and therefore we chose a bacterial-immune model in which the character of manifestation of disturbances was similar to that observed in humans with generalized periodontitis [2, 11]. Now is attached important apoptosis in an initiation and development of inflammatory diseases. There is a disturbance in the balance between proliferation, necrosis and apoptosis of neutrophils in generalized periodontitis [15, 21]. By our experimental researches was established that in conditions of the bacterial-immune periodontitis development, phagocytic activity of blood granulocytes of experimental animals gradually increase. However, for all that our studies also indicated that in process formation of experimental periodontitis is induced cell death, in particular, blood neutrophils. If apoptosis to consider from the point view of one alternatives of cellular division, that provides the homeostasis of inflammatory tissues, it can assume that apoptosis takes a direct part in the pathogenesis of generalized bacterial-immune periodontitis [20]. In a result of the research it was established that at the early stage of the inflammatory process formation in the tissues of the periodontal complex, which included the period from 1^{st} to the 7^{th} day of the experiment, was found an increased total number of dead cells (by 1.62 times; $p<0.01$). At the same time, their high death rate was associated, mainly due to neutrophil granulocytes with signs of apoptosis, which exceeded the

control values by 1.56 times ($p<0.01$) (Figure 1, Table). For cells with signs of late apoptosis / necrosis, their indices were also higher (by 1.83 times; $p<0.01$) as compared to the intact group (Figure 2).

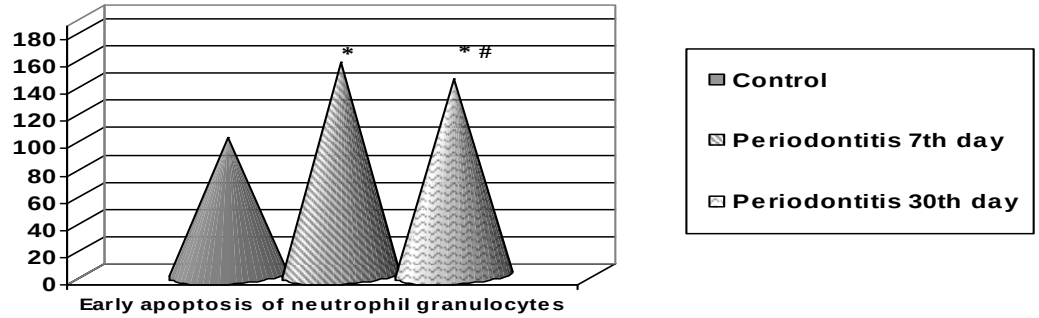

Fig. 1 – The early apoptosis dynamics of neutrophil granulocytes in experimental periodontitis (% of control). Notes: * – significant of differences in relation to the intact animals ($p<0.01$); # – significant differences in relation to the animals with periodontitis on the 7th day of the experiment ($p<0.05$).

It is important to compare the results of the realization of necrosis and apoptosis of blood neutrophils in the experimental bacterial-immune periodontitis. In particular, it was found increase of total number dead cells and their ratio for the inflammatory process with increase their in relation to control and significantly high rates in the earlier stages.

Table

The levels of necrotic and apoptotic changed neutrophilic granulocytes of the rat's blood in the dynamics of the experimental bacterial-immune periodontitis development (M ± m)

Indices	Control, intact animals	Animals with experimental periodontitis	
Experiment duration (days)	-	7	30
Number of animals	10	8	8
Necrotic changed cells, %	1.62±0.05	2.97±0.09 $p_1<0.01$	2,35±0,10 $p_1<0,01$; $p_2<0,01$
Apoptotic changed cells, %	6.29±0.13	9.80±0.13 $p_1<0.01$	9.02±0.34 $p_1<0.01$; $p_2<0.05$
Cells died, %	7.91±0.001	12.78±0.16 $p_1<0.01$	11.37±0.40 $p_1<0.01$; $p_2<0.01$
Unchanged cells, %	92.09±0.16	87.22±0.19 $p_1<0.01$	88.63±0.40 $p_1<0.01$; $p_2<0.01$

Notes: 1. p_1 – significant of differences in relation to intact animals; 2. p_2 – significant of differences in relation to animals with experimental periodontitis on the 7th day of the research.

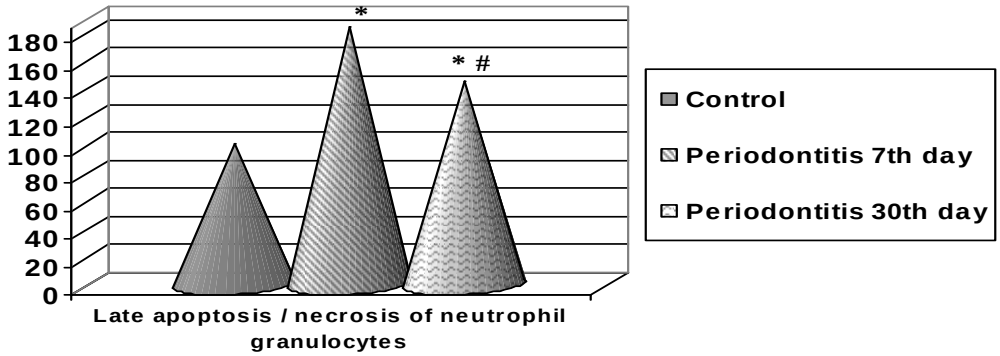

Fig. 2 – The late apoptosis / necrosis dynamics of neutrophil granulocytes in experimental periodontitis (% of control). Notes: * – significant of differences in relation to the intact animals ($p<0.01$); # – significant differences in relation to the animals with periodontitis on the 7th day of the experiment ($p<0.01$).

Analysis of the results obtained on the 30th day of the study showed a similar pattern of changes, that is, an increase in the total number of cells that died as compared to the control group (by 1.44 times; $p<0.01$). In addition, the induced death of neutrophils arose due to both apoptosis and necrosis, the indices exceeded the control values – by 1.43 and 1.45 times ($p<0.01$), respectively.

The number of neutrophils with signs of early apoptosis in the III group was decreased by 1.09 times ($p<0.05$) as compared to the 7th day of the study. The analysis of the neutrophils blood level with signs of late apoptosis / necrosis showed significant lowering it on the 30th day of the experiment in comparison with data on the 7th day of the research – by 1.26 times ($p<0.01$). Analysis of the results obtained on the 30th day of the study showed that the induced death of neutrophils occurred both by apoptosis and necrosis, the values of which exceeded the control values.

Conclusions

1. The formation of experimental periodontitis is accompanied by an increase of annexin-positive (early apoptosis) and necrotic neutrophils content, which is associated with increased intensity of their production to antigen stimulation and may underlying of chronic inflammation in the periodontal complex.

2. In the experimental bacterial-immune periodontitis percentage of neutrophils with signs of cell death significantly increases in the blood. The realization of induced cell death in this modeled pathology occurs mainly due to apoptosis.

References

1. Demkovych AYe, Bondarenko YuI. Patohenetychni osnovy modelyuvannya parodontytu u tvaryn. Zdobutky klinichnoyi i eksperymentalnoyi medytsyny. 2015 Sich;1(22):54-57. [in Ukrainian]
2. Demkovych AYe. Osoblyvosti formuvannya mikrobiotsenozu v rozvytku zapalnykh zakhvoryuvan parodonta. Infektsiyni khvoroby. 2015 Lyut;1(79):87-92. [in Ukrainian]
3. Dimitrova AG, Kolenko YuG. Otsenka effektivnosti razlichnykh immunomodulyatorov v kompleksnom lechenii generalizovanogo parodontita u lits molodogo vozrasta (18-25 let). 2013;2:38-39. [in Russian]
4. Kozak DV, Hudyma AA. Vplyv politravmy na dynamiku piznyoho apoptozu tkanynnykh limfotsytiv. Klinichna khirurhiya. 2013;9:70-72. [in Ukrainian]
5. Orlov AI. Matematika sluchaya: Veroyatnost i statistika – osnovnyye fakty: uchebnoye posobiye. Moskva: MZ-Press; 2004. 100 s. [in Russian]
6. Shmarov DA, Pogorelov VM, Kozinets GI. Sovremennyie aspekty otsenki proliferatsiyi i apoptoza v kliniko-laboratornoy diagnostike (obzor literatury). Klinicheskaya laboratornaya diagnostika. 2013 Yanv;1:36-39. [in Russian]
7. Arimatsu K, Yamada H, Miyazawa H, Minaqawa T, Nakajima M, Ryder MI, et al. Oral pathobiont induces systemic inflammation and metabolic changes associated with alteration of gut microbiota. Sci Rep. 2014 May 6;4:4828.
8. Bayani M, Pourali M, Keivan M. Possible interaction between visfatin, periodontal infection, and other systemic diseases: A brief review of literature. Eur J Dent. 2017 Jul-Sep;11(3):407-410.
9. Berger RL, Casella C. Statistical Inference. 2nd ed. Florida: Duxbury Press; 2001. 374 p.
10. Colombo NH, Shirakashi DJ, Chiba FY, Coutinho MS, Ervolino E, Garbin CA et al. Periodontal disease decreases insulin sensitivity and insulin. J Periodontol. 2012 Jul;83(7):864-870.
11. Demkovych A, Bondarenko Yu, Hasiuk PA. Oxidative modification of proteins in the process of experimental periodontitis development. Interventional Medicine and Applied Science. 2017 Dec;9(4):218-221.
12. Gross AJ, Paskett KT, Cheever VJ, Lipsky MS. Periodontitis: a global disease and the primary care provider's role. Postgrad Med J. 2017 Sep;93(1103):560-565.
13. Herrmann JM, Meyle J. Neutrophil activation and periodontal tissue injury. Periodontol 2000. 2015 Oct;69(1):111-127.
14. Hirschfeld J. Dynamic interactions of neutrophils and biofilms. J Oral Microbiol. 2014 Dec 17;6:26102.
15. Jia SH, Parodo J, Charbonney E, Tsanq JLY, Jia SY, Rotstein OD, et al. Activated neutrophils induce epithelial cell apoptosis through oxidant-dependent tyrosine dephosphorylation of caspase-8. Am J Pathol. 2014 Apr;184(4):1030-1040.
16. Li Y, Lu Z, Zhang X, Yu H, Kirkwood KL, Lopes-Virella MF, et al. Metabolic syndrome exacerbates inflammation and bone loss in periodontitis. J Dent Res. 2015 Feb;94(2):362-370.
17. Looney MR, Matthay MA. Neutrophil sandwiches injure the microcirculation. Nat Med. 2009 Apr;15(4):364-366.
18. Maianski NA, Maianski AN, Kuijpers TW, Roos D. Apoptosis of neutrophils. Acta Haematol. 2004;111(1-2):56-66.
19. Meyle J, Chapple I. Molecular aspects of the pathogenesis of periodontitis. Periodontol 2000. 2015 Oct;69(1):7-17.
20. Mukherjee S, Kundu D. Study of neutrophils isolated from peripheral blood of patients suffering from aggressive periodontitis at the cellular level: Receptors and cytoskeletal reorganization. J Indian Soc Periodontol. 2012 Jan;16(1):59-64.
21. Srinivas M, Chethana KC, Padma R, Suraqimath G, Anil M, Pai BS, et al. A study to assess and compare the peripheral blood neutrophil chemotaxis in smokers and non smokers with healthy periodontium, gingivitis, and chronic periodontitis. J Indian Soc Periodontol. 2012 Jan;16(1):54-58.
22. Srivastava N, Nayak PA, Rana S. Point of Care – A Novel Approach to Periodontal Diagnosis – A Review. J Clin Diagn Res. 2017 Aug;11(8):ZE01-ZE06.

Реферати

РОЛЬ НЕКРОТИЧНИХ ТА АПОПТИЧНИХ ЗМІН УНЕЙТРОФІЛЬНИХ ГРАНУЛОЦИТАХ В РОЗВИТКУ ЕКСПЕРИМЕНТАЛЬНОГО БАКТЕРІАЛЬНО-ІМУННОГО ПАРОДОНТИТУ

Демкович А. Є.

Механізми розвитку запального процесу в пародонтальному комплексі включають низку складних процесів, що приводять до генералізації і хронізації його, втрати зубів та появи ускладнень з боку інших органів. Одну з ключових ланок в імунній системі займає клітинний неспецифічний імунітет, який є не тільки інструментом протиінфекційного захисту, але й універсальним ефектором гомеостазу. У статті наведено результати досліджень показників раннього та пізнього апоптозу нейтрофільних гранулоцитів крові на 7-му і 30-ту добу розвитку запального процесу в тканинах пародонту. При цьому виявлена характерна динаміка змін кількості загиблих клітин в процесі формування

РОЛЬ НЕКРОТИЧЕСКИХ И АПОПТИЧЕСКИХ ИЗМЕНЕНИЙ НЕЙТРОФИЛОВ В РАЗВИТИИ ЭКСПЕРИМЕНТАЛЬНОГО БАКТЕРИАЛЬНО-ИММУННОГО ПАРОДОНТИТА

Демкович А.Е.

Механизмы развития воспалительного процесса в пародонтальном комплексе включают ряд сложных процессов, приводящих к генерализации и хронизации его, потери зубов и появления осложнений со стороны других органов. Одну из ключевых звеньев в иммунной системе занимает клеточный неспецифический иммунитет, который является не только инструментом противоинфекционной защиты, но и универсальным эффектором гомеостаза. В статье приведены результаты исследований показателей раннего и позднего апоптоза нейтрофилов крови на 7-ю и 30-е сутки развития воспалительного процесса в тканях пародонта. При этом выявлена характерная динамика изменений количества погибших клеток в процессе формирования воспалительного

запального вогнища у пародонтальному комплексі. Зокрема, перебіг експериментального пародонтиту супроводжувався підвищенням вмісту алексин-позитивних (ранній апоптоз) та некротизованих нейтрофілів, що пов'язано з посиленням інтенсивності їх утворення у відповідь на антигену стимуляцію. При даній модельованій патології реалізація індукованої смерті клітин відбувалася переважно шляхом апоптозу.

Ключові слова: Пародонтальний комплекс, запалення, нейтрофільні гранулоцити, апоптоз, некроз.

Стаття надійшла 16.01.18 р.

очага в пародонтальном комплексе. В частности, ход экспериментального пародонтита сопровождался повышением содержания анексин-положительных (ранний апоптоз) и некротизированных нейтрофилов, что связано с усилением интенсивности их образования в ответ на антигенную стимуляцию. При данной моделируемой патологии реализация индуцированной смерти клеток происходила преимущественно путем апоптоза.

Ключевые слова: Пародонтальный комплекс, воспаление, нейтрофильные гранулоциты, апоптоз, некроз.

Рецензент Денефіль О.В.

DOI 10.26724 / 2079-8334-2018-2-64-142-145
UDC 616-092+616.24+616.37-002+616-08

L.M. Zaiats, V.V. Cherkasova
HSEE "Ivano-Frankivsk National Medical University", Ivano-Frankivsk

ULTRASTRUCTURAL CHANGES IN PULMONARY HEMOMICROCIRCULATION AT ACUTE EXPERIMENTAL PANCREATITIS

E-mail: kaliostrovik85@gmail.com

Experiment performed on 70 white male rats of the Vistar line by electron microscopic method, dynamics (12, 24, 48, 72 h) of ultrastructural changes of the hemomycocirculatory bed of lungs in experimental acute pancreatitis was studied. Established, that at 12 h after the beginning of the experiment there are violations of the submicroscopic structure of the hemomycocirculatory bed of the lungs. In hemocapillaries of the alveolar wall, excessive accumulation of leukocytes, their adhesion and aggregation is noted. With the duration of the study (24-72 h) in the hemomicrocirculatory bed of the lungs are defined as dystrophic-destructive as compensatory-adaptive changes.

Key words: lungs, hemomicocirculatory bed, acute experimental pancreatitis.

The present study is a fragment of the research work "Pathogenetic Development Mechanisms of Changes in the Respiratory, Endocrine, Nervous Systems in Case of Simulated Pathological Conditions and their Correction" (number of state registration 0117U001758).

Numerous clinical and experimental studies have shown that lungs are one of the first target organs that can be damaged in various critical states (sepsis, polytrauma, acute pancreatitis, peritonitis, acute renal failure, thermal injuries, acute blood loss) [8,7,9,11,14]. At the same time, under the influence of various extreme factors there is a violation of the morphofunctional state, constituent components of the aerohematous barrier, which underlies the development of syndrome acute lung injury (ALI) [1,4,5,13].

The purpose of the research was to study in dynamics hemomicrocirculatory bed of the lungs in acute experimental pancreatitis.

Materials and methods. Experiments were performed on 70 white male rats weighing 180-220 g. Animals were divided into 3 groups: I - Intact group of animals (n = 10); II - control (n = 20); III - with a model of acute pancreatitis (n = 40). All studies were performed under general anesthesia using ketamine (40 mg / kg). Animal retention and manipulation were carried out in accordance with the provisions of the Law of Ukraine "On the Protection of Animals from Cruelty" (No. 1759-VI of 15.12.2009). Acute experimental pancreatitis was reconstructed by two intraperitoneal injections of 20% solution of L-arginine in a total dose of 5 g/kg with a one-hour interval [13]. Control group of animals was injected equivalent dose of physiological solution. Pulmonary tissue collection for electron microscopic examination was performed under ketamine anesthesia after 12, 24, 48 and 72 hours. The material was fixed in 2.5% glutaraldehyde solution, followed by fixation in a 1% solution of osmium tetrachloride. After dehydration, the material was poured into epon-aralgit. Cuts obtained on ultramicrotome "PEM-125K".

Results of the study and their discussion. An analysis of the results of an electron microscopic study showed that after 12 h after the beginning of the experiment in the hemocapillaries of the alveolar wall, an increased number of neutrophilic leukocytes, their aggregation and adhesion to the endothelial cells (Fig. 1) is observed. Endothelial cell nuclei with a matrix of mean electron-optical density. The chromatin granules are substantially uniformly distributed throughout the core area. The nucleolem has winding contours and forms a shallow invagination. At the same time, separate endothelial cells with low electron-optical density nuclei and marginal distribution of chromatin granules are noted. Mitochondria of different size and shape with an enlightened matrix and partially reduced crests. Cisterns and channels

of the Golgi apparatus (GA) and rough endoplasmic reticulum (RER) are unevenly expanded. In the peripheral cytoplasmic sites, both small and large microvesicles are observed. On the luminal surface of some endothelial cells there are microvessels that protrude into the lumen of hemocapillaries.

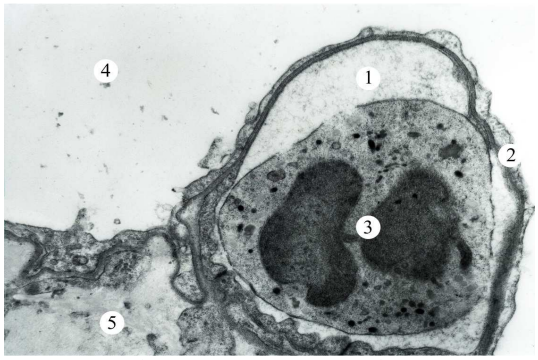

Fig. 1. Adhesion of leukocytes to the endothelium of the hemocapillary wall of the alveoli after 12 h of experiment. Marking: 1 - lumen of hemocapillary; 2 - peripheral part of the endothelial cell; 3 - neutrophilic leukocyte; 4 - lumen of the alveoli; 5 – interstitium. Electronic microphotography. Magn.: x9600.

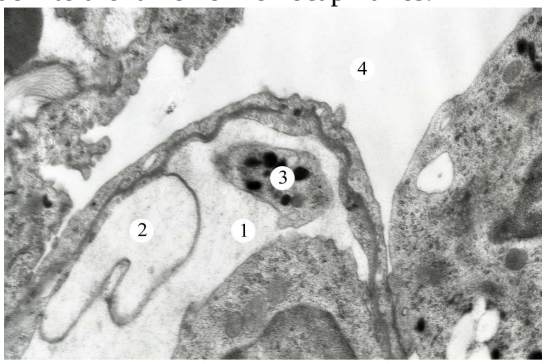

Fig.2. Ultrastructure organization of the hemocapillary wall of the alveoli in 24 h after the experiment. Markings: 1 - lumen of hemocapillary; 2 - sail-like protrusion of the plasma of the endothelium in the lumen of the hemocapillary; 3 - platelet; 4 - lumen of the alveoli. Electronic microphotography. Magn.: x6400.

24 hours after the beginning of the experiment in the lumen of many hemocapillaries, red blood cells are detected, adhesion and aggregation of leukocytes and platelets. In the lumen of individual hemocapillaries, along with cellular elements, amorphous, nonstructural, electron-dense masses and destructively altered fragments of organelles are detected. Endothelial cells with matrix of low electron-optical density. Granular chromatin concentrates near the nuclear membrane. Nuclear space extended. Mitochondria are swollen with an enlightened matrix. In some cells there is a focal destruction of the crests, fragmentation and destruction of the internal membrane of mitochondria. GA tanks are vacually expanded. In many endothelial cells, fragmentation of the RER membranes and a sharp decrease in the number of ribosomes associated with its wall are observed.

As a result of edema of endothelial cells and aggregation of blood cells, the lumen of many hemocapillaries is sharply narrowed or closed. Basement membrane of hemocapillaries lengthened and thickened considerably showing fuzzy contours. In separate endothelial cells on the luminal surface of plasmollem there are sail-like protrusions (Fig. 2). Sometimes in hemocapillaries there are marked areas of lysis of luminal plasmollem, which is accompanied by the release of intracellular contents into the lumen of the microvessel. The submicroscopic analysis performed in 48 h after the start of the experiment, showed that the edema phenomenon in the endothelial cells continues to be maintained, but to a lesser extent expressed in comparison with the previous term of the study. Endothelial cell nuclei with low electron-density matrix, and marginal aggregation of chromatin granules is observed. Mitochondria are enlarged in volume with single disorientated ridges. Along with the expanded elements of the GA, fragmentation of the RER membranes is noted. Basement membrane is uneven, the alternation of thickened and narrow sections of it is revealed.

With the extension of the study (72 h), the alterations in the structural organization of hemocapillaries are more local in nature. Round-shaped nuclei with fine-grained nucleoplasma are seen. The nuclear membrane has winding contours and forms profound invaginations. Field around the nuclear space is expanded. Mitochondria are swollen, crests lose their parallelism, number of it is reduced. GA is represented by expanded tanks, vacuoles and bubbles. RER channels are expanded, filled with low electron-optical density content. In some cells the fragmentation of the RER membranes is noted, the number of ribosomes on the membranes of RER is reduced. Basement membrane locally thickened. The peripheral zone of the endothelial cells is sometimes enlarged, and sometimes sharply thinned with a significantly reduced number of mikropinocytosic vacuoles. In the lumen of hemocapillaries, adhesions, aggregation of leukocytes and aggregates of erythrocytes are found (Fig. 3). However, endothelial cells with signs of high functional activity are noted. In the cytoplasm of such cells, mitochondria of small size with a matrix of moderate electron-optical density are detected. The components of the GA are slightly enlarged. RER tanks are hypertrophied, rich in ribosomes. The performed experiments showed that after 12 h after the modeling of acute pancreatitis in the lungs there is a violation of hemomicrocirculation, as evidenced by the increased number of neutrophils in the lumen of the blood capillaries, their aggregation and adhesion to endothelial cells. Several other scientists point out the regional sequestration of neutrophils in the lungs, their adhesion and aggregation in acute lesions [6, 7]. Adhesion of neutrophils to the endothelium is the cause of the formation and release of oxygen radicals, as well as secretory degranulation. In this case, proteases (cathepsins, collagenase, elastase) of activated leukocytes damage not only the endothelium of hemocapillaries, but also the basal membrane.

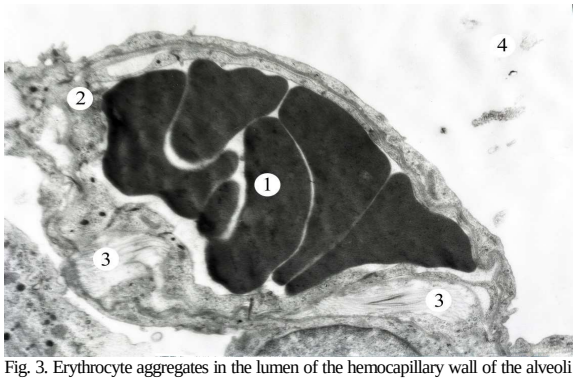

Fig. 3. Erythrocyte aggregates in the lumen of the hemocapillary wall of the alveoli on 72 h of the experiment. Marking: 1 - erythrocyte; 2 - peripheral part of the endothelial cell; 3 – interstitial space; 4 - lumen of the alveoli. Electronic microphotography. Sat.: x6400.

This is especially true for elactase [8, 10]. Destruction of granules of neutrophils, especially azurophilic ones, took place in our studies. With the continuation of the study period (24-72 h), an increase in the permeability of hemocapillaries is observed, which leads to the release of a part of the plasma and neutrophils in the interstitium and lumen of the alveoli with the development of interstitial and intraalveolar non-cardiogenic pulmonary edema. In this case, in hemocapillaries, along with the aggregation of leukocytes, there is an erythrocytic sludge and platelet aggregation, indicating a marked violation of hemomicrocirculation.

Changes in a similar nature under various critical states are noted by a number of other researchers [2, 12].

Conclusions

1. Studies have shown that acute L-arginine-induced pancreatitis is accompanied by pronounced changes in the submicroscopic structure of the hemomicrocirculatory bed of the lungs.
2. The nature and severity of ultrastructural changes in the hemomicrocirculatory bed of the lungs depends on the duration of the endogenous factor.

The prospect of further research: the study of the ultrastructural organization of other components of the aerohematic barrier in experimental acute pancreatitis is in the perspective of further research.

References:

1. Avramenko AO, Smolyakov SM Patomorfologichni zminy u legeneviy tkanyni shchuriv cherez 6 and 24 hodyny pislya vnutrishnyoshlunkovoho vvedennya 2.5% vodnoho rozchinu amiaku. Klinichna ta Eksperimentalna Patologiya. 2016; 4 (58): 3-6. [in Ukranian]
2. Chernyayev AL Etiologiya, patogenez and patologicheskaya anatomy diffuznykh alveolarnykh porazheniy. Obshchaya reanimatologiya. 2005; 1 (5): 13-6. [in Russian]
3. Kassil VL Ostryi vnelegochnoy resoiratornyi sindrom distressa: opredeleniye, etiopatogenes, klinicheskiye i laboratornyie proyavleniya (obzor literatury c elementami kritiki). Klinicheskaya onkogematologiya. 2011; 4 (1): 54-65. [in Russian]
4. Kopichak IR Morfofunktsionalni zminy u lehenyakh z izolyovanymy ta kombinovanymy urazhennyamy. Klinichna khirurhiya. 2014; 1: 36-39. [in Ukranian]
5. Novikov NU, Tyshkevich LV, Jansuz KN Patomorphologicheskiye izmeneniya aerogematicheskogo barriera pri ostrom syndrome respiratornogo distressa v experimente. Tavricheskiy vestnik meditsiny i biologiyi. 2012; 15 (1): 169-175. [in Russian]
6. Orel YM Uchast neutrophilnykh granulotsytiv u rozvytku morphologichnykh zmin u lehenyakh pry yikh hostromu urazhenni v experymenti. Klinichna khirurhiya. 2015; 1: 43-5. [in Ukranian]
7. Teslyuk II. Krytychni stany: syndrome hostroho respiratornoho distressu. Terapiya. 2010; 11 (52): 41-3. [in Ukranian]
8. Wildman VN Ultrastructurnyie izmeneniya v respiratornykh kletkakh legkikh experimentalnykh zhyvotnykh s simulyatsiyei zakrytoy travmy grudi. Meditsina segodnya i zavtra. 2010; 2-3 (47-48): 36-44. [in Russian]
9. Cruz-Santamaria DM, Taxonera C, Iner M Update on pathogenesis and clinical management of acute pancreatitis. World J Gastrointest. Pathophisiol. 2012; 3(3):60-70.
10. Matthay MA, Zimmerman GA Acute lung injury and the acute respiratory distress syndrome: four decades of inquiry into pathogenesis and rational management. Am. J. Respir. Cell Mol.Biol. 2005; 33(4): 319-27.
11. Singh VK, Bollen TL, Wu BU, Kathryn Repas, Rie Maurer, Song Yu et al. An assessment of the severity of interstitial pancreatitis. Clin. Gastroenterol. Hepatol. 2011; 9:1098-103.
12. Williams AE The mercurial nature of neutrophils: still an enigma in ARDS? American J. of Physiology - Lung Cellular and Molecular Physiology. 2014; 306(3): 217-30.
13. Xi-Ping Zhang, JieZhang, Mei-Li Ma, Cai Y, Xu RJ, Xie Q, et.al Pathological changes at early stage of multiple organ injury in a rat model of severe acute pancreatitis. Hepatobiliary Pancreat Dis Int. 2010; 9(1):83-7.
14. Yap SC, Lee HT Acute kidney injury and extrarenal organ dysfunction. Anesthesiology. 2012; 166(5): 1139-48.

Реферати

УЛЬТРАСТРУКТУРНІ ЗМІНИ ГЕМОКАПІЛЯРІВ ЛЕГЕНЬ ПРИ ЕКСПЕРИМЕНТАЛЬНОМУ ГОСТРОМУ ПАНКРЕАТИТІ

Заяць Л.М., Черкасова В.В.

У дослідах на 70 білих щурах-самцях лінії Вістар електронномікроскопічним методом вивчено в динаміці (12, 24, 48, 72 год.) ультраструктурні зміни гемомікроциркуляторного русла легень при експериментальному гострому панкреатиті. Встановлено,

УЛЬТРАСТРУКТУРНЫЕ ИЗМЕНЕНИЯ ГЕМОКАПИЛЛЯРОВ ЛЕГКИХ ПРИ ЭКСПЕРИМЕНТАЛЬНОМ ОСТРОМ ПАНКРЕАТИТЕ

Заяц Л.М., Черкасова В.В.

В опытах на 70 белых крысах-самцах линии Вистар электронномикроскопическим методом изучено в динамике (12, 24, 48, 72 ч.) ультраструктурные изменения гемомикроциркуляторного русла легких при экспериментальном остром панкреатите. Установлено, что