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MORPHOLOGICAL STATE OF THE RENAL MEDULLA IN RATS IN CASE OF AN EX- PERIMENTAL BURN INJURY UNDER CONDITIONS OF GEKOTON

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Kovalchuk O.I., Cherkasov V.G., Pastukhova V.A., Malikov O.V. Morphological state of the renal medulla in rats in case of an experimental burn injury under conditions of gekoton.

ABSTRACT. Background. The article presents structural changes of the renal medulla in experimental traumatic skin injury in rats under conditions of intravenous infusion of a colloid-hyperosmolar solution of gekoton. It was found that gekoton acts on the structure of the body as a cytoprotector. **Objective.** To study structural changes of the renal medulla in case of an experimental skin burn injury in rats under conditions of an intravenous infusion of gekoton. **Methods.** Macroscopic, histological, electron microscopic, laboratory, statistical analysis. The experimental study of morphological changes of the renal medulla in case of burn disease (within 1, 3, 7, 14, 21, 30 days) under condition of exposure to 0,9 % NaCl solution and an infusion of colloidal hyperosmolar drugs with detoxicating, rheological, energetic, antishock effect gekoton and lactoproteinum with sorbitol has been executed in 90 male Wistar rats of 155-160 g. **Results.** The destruction of microvilli of limbus penicillatus and the breakage of apical region epithelial cells cytoplasm of proximal convoluted tubules of the nephron are typical for the renal medulla in rats with skin burns which were given the gekoton solution during the first three days, one and three days after the experiment began. **Conclusion.** In case of an experimental skin burn of II-III grade of 21-23 % of body surface area in rats a remarkable cytoprotective effect of gekoton on the structure of the renal medulla is a morphologic equivalent of positive effect of an intravenous infusion of gekoton. The above-mentioned cytoprotective effect is caused by the induction of mitochondria hypertrophy and hyperplasia, as well as the stimulation of mitophagy which provides the removal of damaged mitochondria and suppresses the progress of cell apoptosis.

Key words: burn, renal medulla, light and electron microscopy.

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Introduction

Pathogenesis and treatment of burns is a topical and not enough elaborated issue [1].

However, it has been established that the administration of infusions of hyperosmolar solutions in case of experimental skin burns of II-III grades of 21-23 % body surface area has an effective influence

over endogenic intoxication [2], which causes an increase of catabolism level, destruction of cellular and non-cellular components of the organs [3, 4, 5] and which is the cause of numerous characteristic burn disease manifestations of multiple organ failure.

The thematic justification of this research is

conditioned by the fact that by now an analysis of the indexes of structural changes of the renal medulla in case of burn disease under conditions of therapy with an infusion of colloidal hyperosmolar solutions of lactoproteinum with sorbitol has not been studied as a separate subject of research.

Research objective – to study structural changes of the renal medulla in case of an experimental skin burn injury in rats under conditions of an intravenous infusion of gekoton.

Subject and methods of research

The experimental study of morphological changes of the renal medulla in case of burn disease (within 1, 3, 7, 14, 21, 30 days) under condition of exposure to 0,9 % NaCl solution and an infusion of colloidal hyperosmolar drugs with detoxicating, rheological, energetic, antishock effect gekoton and lactoproteinum with sorbitol has been executed in 90 male Wistar rats of 155-160 g.

Colloidal hyperosmolar solution gekoton which was administered is developed in the State Institution «Institute of Blood Pathology and Transfusion Medicine of National Academy of Medical Sciences» (Lviv). The preparation contains as a colloidal basis poly(0-2-hydroxyethyl) starch (average molecular weight is 130 000 dl, molar substitution degree is 0.4) – 5 % as well as polyatomic alcohol xylitol – 5 %, alkalization component sodium lactate – 1,5 %, sodium chloride – 0,8 %, potassium chloride – 0,03 %, calcium chloride – 0,02 %, magnesium chloride – 0,01 %. Ion composition of the solution has the following structure: Na^+ – 270,7 mmol/L, K^+ – 4,0 mmol/L, Ca^{++} – 1,8 mmol/L, Mg^{++} – 1,1 mmol/L, Cl^- – 146,6 mmol/L, $\text{CH}_3\text{CH}(\text{OH})\text{COO}^-$ – 133,8 mmol/L. Theoretical osmolarity of the study drug is 890 mosmol/L, three-fold osmolarity of an isotonic NaCl solution and blood plasma osmolarity [6].

The maintenance and procedures with the animals were executed in accordance with «General Ethical Principles for Experiments in Animals» approved by the First National Congress on Bioethics (Kiev, 2001), and they were regulated by the recommendation of «European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes» (Strasbourg, 1985) and the provisions of the «Regulations of Preclinical Safety Evaluation of Pharmacological Agents (GLP)».

The animals were divided into 7 groups: I – untreated animals; II, III, IV – rats without a thermic injury to which a separate infusion of 0,9 % NaCl solution, gekoton and lactoproteinum with sorbitol in dose of 10 ml/kg, respectively, was given; V, VI, VII – animals with burns which were given the study substances according to the similar schedule and similar dose regime.

A burn (after an appropriate premedication) was caused by an application of four copper plates to lateral areas of an animal's trunk (two plates on ei-

ther side) which had been preliminary put into water with constant temperature 100 °C for six minutes. The total burn area in rats of the above mentioned weight was 21-23 % with an exposure 10 s, that is enough to form a burn of II grade – a dermal surface burn (former III-A grade) and to cause a state of shock of medium severity.

The study solutions were administered intravenously during 5-6 min. in a dose of 10 ml/kg-BW. The infusion was administered into the inferior vena cava where a catheter was inserted through the femoral vein in aseptic conditions. The catheter inserted into the femoral vein was stitched under the skin. Its lumen was filled with a titrated solution of heparin along the whole length (0,1 ml of heparin for 10 ml of 0,9 % NaCl solution) after each administration of the substances. The solutions were administered first 1 hour after modelling a pathological state, further infusions were administered daily during 7 days in total.

Our previous studies demonstrated that without any pharmacocorrection on the background of skin burn injury all male rats died on 9th day of the experiment and on 7th day the lethality was 80 %.

In the group of animals with skin burn injury which were given 0,9 % NaCl solution a progressive increase of lethality rate from 5 % in one day to 11 % within the period from 4th to 7th day with the following gradual decrease of this index value to 3% in the period from 22nd to 30th day after skin burn has been detected. The total lethality rate in the group of male rats which were given 0,9 % NaCl solution was 43,5 %. A separate medical course therapy given to rats with skin burn injury with the use of gekoton similar to the one with lactoproteinum with sorbitol considerably prevented the death of the animals during all the period of monitoring.

The statistical analysis of the investigation results was executed in the package STATISTICA 5,5 (it belongs to the Centre of New Information Technologies of Vinnytsia National Medical University of M. I. Pyrogov. License №AXXR910A374605FA) with the use of nonparametric methods of evaluation of the results obtained. The correctness of distribution of the signs according to each of the obtained rows, average values according to each sign which were studied and standard deviations were assessed. The confidence of difference in values between independent quantitative values was determined with the use of Mann-Witney U-test.

Sampling was executed under anesthesia. The animals were decapitated and after that abdomen opening was executed and small pieces of the renal medulla were cut out with a blade. The material for morphological studies was elaborated according to general methods.

Ultrathin sections were prepared with the use of an ultramicrotome LKB, they were examined and shoot on an electronic microscope ПЕМ-125K. Semi-fine sections were dyed with toluidine blue and me-

thylene blue – azure II. Histologic sections were dyed with heamatoxylin pikrofuksin and heamatoxylin eosin. Morphometric studies of histologic preparations were executed with the use of a microscope Olympus BX 51. The obtained results were statistically elaborated with the use of Student's t-test.

An electron-microscopic study was executed on the basis of the Department of Electronic Microscopy (Academic Adviser Prof. L. O. Stechenko) of the Institute of Pathology Problems of Bogomolets National Medical University.

Research results and discussion

The destruction of microvilli of limbus penicillatus and the breakage of apical region epithelial cells cytoplasm of proximal convoluted tubules of the nephron are typical for the renal medulla in rats with

skin burns which were given the gekoton solution during the first three days, one and three days after the experiment began (Fig. 1).

These modifications were observed on the background of destruction of mitochondria, formation of lysosomes and autophagosomes (mitophagosomes). Most often the mitochondria pathology is expressed in matrix focal clearing, partial or total disappearance of cristae, swelling, damage of internal membrane integrity. The internal membrane of some mitochondria is not detected and the organelle is converted into a vacuole, but such vacuoles are bigger than primary vacuoles (which are detected in cytoplasm of epithelial cells in a norm) and the residues of the cristae or the internal membrane allow their origin to be specified from mitochondria.

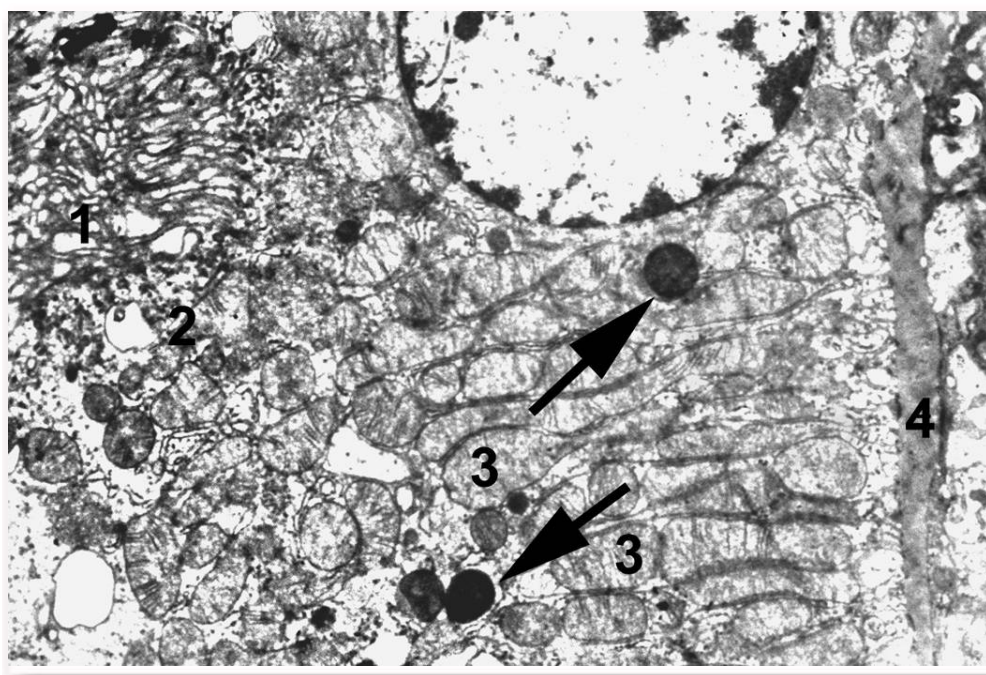


Fig. 1. Destruction of microvilli of limbus penicillatus and the breakage of the apical region of epithelial cells cytoplasm of nephron proximal convoluted tubule in the renal medulla in a rat with skin burn injury which was given gekoton once daily since the beginning of the experiment. Autophagosomes (mitophagosomes are densely filled with a content of high electron density) are indicated with arrows. 1 – destroyed microvilli; 2 – broken apical region of an epithelial cell's cytoplasm; 3 – mitochondrion; 4 – basic membrane. $\times 18000$.

While assessing the state of mitochondria it is important to emphasize morphological signs of irreversibility of their changes. First of all they are: destruction of the membrane limiting the mitochondrion that results in decomposition of the organelle. A sign of irreversible changes of a damaged mitochondrion is also its fusion with a lysosome what leads to cristae homogenization and to the creation of an autophagosome (a mitophagosome) which looks like a vacuole densely filled with quite a homogenous material consisting of osmiophilic and osmiophobic areas (Fig. 1). In some mitophagosomes the residues of membrane and/or globular inclusions of high electron density remarkably seen on the background of electronically-transparent

matrix surrounded with the conserved organelle's membrane are detected.

The described phenomenon completely meets the picture of selective form of mitochondria autophagy or mitophagy [7], which final stage is a complete (or partial) digestion of phagosome's content and the release of the latter out of cytoplasm.

It should be noted that the mitophagy quite often is not associated with destruction of microvilli of limbus penicillatus and the breakage of apical region of an epithelial cell's cytoplasm (the mitophagy has an adaptive nature). But sometimes the mitophagy is associated with destruction of microvilli of limbus penicillatus and the breakage of apical region of an epithelial cell's cytoplasm (adaptation upset). As a

rule the mitophagy is registered on the background of moderate increase of number and size of mitochondria (compensatory reaction). It cannot be ruled out that it is a moderate mitophagy that makes possible a complete or partial conserving (the basic area of cytoplasm remains undamaged) the epithelial cell and the area of basement membrane adjacent to it. The basement membrane appears quite homogenous and it consists of small-globular material of moderate electronic density.

Within 3 days after the skin burn mitochondria of different form and size (giant mitochondria, mito-

chondria with constrictions and buds of different form) are detected in cytoplasm of epithelial cells of renal tubules (Fig. 2). This phenomenon meets the established view [8] about the new growth of mitochondria in the way of budding. The process of mitochondria hypertrophy and hyperplasia is performed on the background of selective autophagy of a part of them. On the final phase of their development the autophagosomes look like autophagic vacuoles filled with electronically transparent contents.

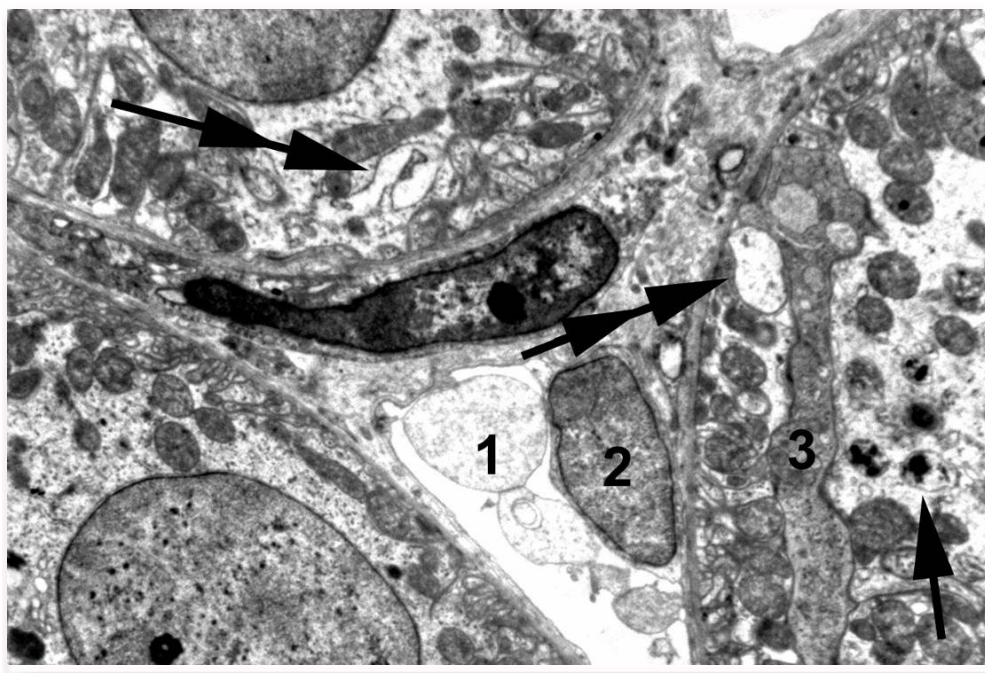


Fig. 2. Peritubular blood capillary and renal collecting tubules in the renal medulla of a rat with skin burn injury to which was given gekoton during 3 days, 3 days after the experiment began. Mitophagosomes with partly lysed content are indicated with single arrows; autophagic vacuoles are indicated with double arrows. 1 – capillary lumen; the nucleus of an epithelial cell; 2 – giant mitochondrion in cytoplasm of an epithelial cell of renal collecting tubule. $\times 5000$.

These vacuoles' form and size are approximately correspondent to the form and size of mitochondria, that is why there is a reason to consider that not only «old», but also “young” mitochondria in the phase of «budding» can be injured (and lysed as a consequence of the autophagy).

In this follow-up period the wall of peritubular blood capillaries conserves its typical structure. In the lumen of blood microcirculation vessel sometimes the cell debris is detected (most often the residues of lysed red blood cells).

The processes of mitophagy, destruction of certain groups of mitochondria, as well as mitochondria hypertrophy and its new growth (budding of large mitochondria and small mitochondria formation) are typical for the cells of the renal medulla in rats with burns 7 days after daily injection of gekoton. The fact that the above mentioned processes are moderate and they are not associated with either apoptotic or necrotic cell disruption is the evidence of its ef-

fectiveness. Under these conditions, particularly, the microvilli of limbus penicillatus of epithelial cells of proximal convoluted tubule of the nephrons conserve their structure undamaged. There is a gradient of motion (transport) of autophagic vacuoles directed to apical area of epithelial cells cytoplasm and a similar gradient of mitochondria damage and forming of mitophagosomes. This is what can allow us to explain the resistance of cytoplasm basal areas (and then, basement membrane) and the tendency of apical areas of cytoplasm (and microvilli of limbus penicillatus related to them) to destruction. Even if the microvilli of limbus penicillatus conserve their structure there is a tendency to accumulate mitochondria with cleared matrix and with destroyed cristae, mitophagosomes, autophagic vacuoles and areas of autophagic lysis on the apical pole of cytoplasm of epithelial cells (Fig. 3). We have never registered such a phenomenon in the norm.

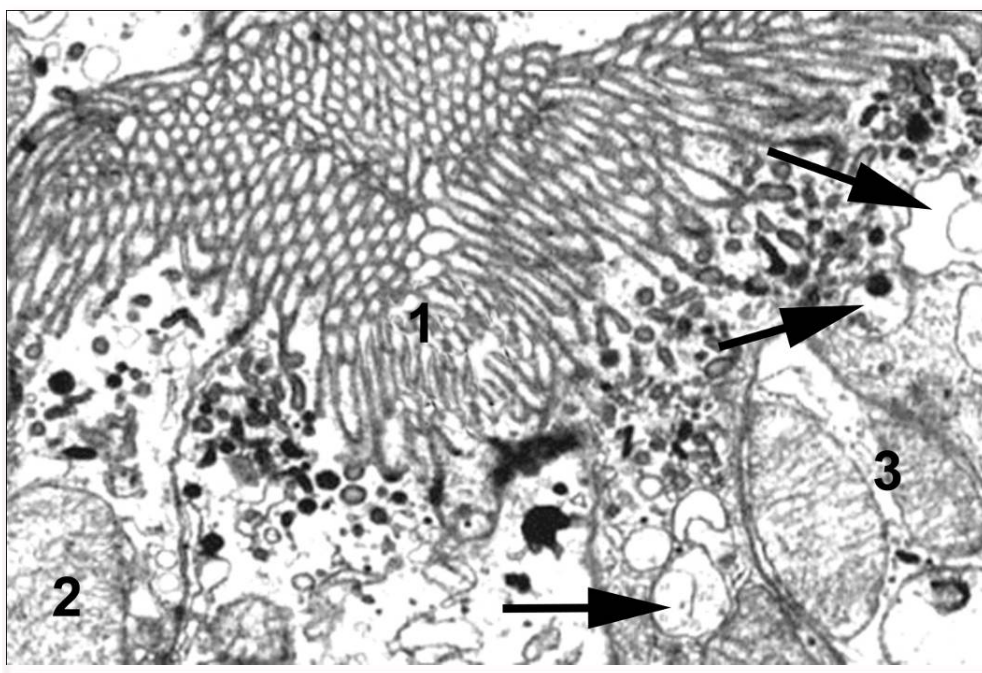


Fig. 3. Accumulation of mitochondria with signs of destruction, mitophagosomes, autophagic vacuoles and autophagic lysis areas on the apical pole of an epithelial cell of the proximal convoluted tubule of the nephron in the renal medulla in a rat with skin burn injury which were given gekoton solution during 7 days after the beginning of the experiment, 7 days after the experiment had begun. Autophagic vacuoles are indicated with arrows. 1 – structurally conserved microvilli of limbus penicillatus; 2 – mitochondrion with cleared matrix and destroyed cristae; 3 – area of autophagic lysis. $\times 24000$.

In some cells of the renal medulla in rats with skin burn injury to which gekoton solution was administered during 7 days after the beginning of the experiment, 14 day after the beginning of the experiment a massive autophagic cytoplasm vacuolization was noted. Even in cases when such a massive autophagic vacuolization has focal (areal) nature, it leads to cell-cell collaboration disorder. This results, particularly, in epithelial cells removal (exfoliation) in the tubular lumen. In such cells some signs of excessive mitophagy (microautophagy is converted into macrophagy) have been detected: the autophagic vacuoles are fused with each other (as well as with separate mitophagosomes) and form lysis areas limited by the membrane.

The removal of the contents of single vacuoles is executed by virtue of fusion of membranes of an autophagic vacuole with plasmatic membrane of a cell and, in this case, the separating (with an outside medium) function of the plasmalemma is conserved. However, in case of massive autophagic vacuolization the vacuoles and mitophagolysosomes fusion (in different phases of maturation) results in «vacuolar explosion» when the membrane is fragmented into “pieces” and its separating function levels out. The areas of autophagic lysis are burst out through the cytomembrane, initiating in this way the progress of necrotic destruction of a cell (Fig. 4).

The excess of mitophagy in cytoplasm of epithelial cells of the renal tubules within the indicated period of time is demonstrated not only on the level of one cell (resulting in massive vacuolization

of cytoplasm), but on the level of groups of epithelial cells (a peculiar «summarized excess» in the form of total increase of mitophagosomes in the epithelium of the tubules). This is remarkably registered in semifine sections (Fig. 5) with a presence of numerous clumps of mitophagosomes in the cytoplasm of epithelial cells of tubular walls and in the cytoplasm of epithelial cells which are exfoliated into the tubular lumen.

We have not detected the processes of mitophagy and hypertrophy and new growth of mitochondria in the cells of the renal medulla in rats with skin burn injury to which gekoton solution was administered during 7 days after the beginning of the experiment, 21 and 30 days after the beginning of the experiment. During this period of follow-up a segmental, irregular reduction of areas of hyperosmotic cytoplasm, their clasmatosis, subtotal (and sometimes, total) peeling the deformed and fragmented hyperosmotic cells off the basal membrane has been detected (Fig. 6). This phenomenon reminds the phenomenon of anoikis which The Nomenclature Committee on the Cell Death proposes to consider a kind of classical apoptosis [9].

Nowadays in scientific literature [7, 9] the following types of cell death are mentioned: 1) macroautophagy (or the autophagy itself); 2) microautophagy or selective autophagy to which particularly belongs the mitophagy. The paradox of autophagy phenomenon consists in the fact that it can be not only a variation of realization of thanatogenic signal, but, on the contrary, the cell's survival programme.

After skin burn injury under conditions of an infusion of gekoton we have observed two kinds of mitochondria death in the cells of the renal medulla: 1) breakdown of the cristae and limiting membranes

with the following organelle disintegration (that can be assessed as a component of necrotic modifications in the cell); 2) mitophagy.

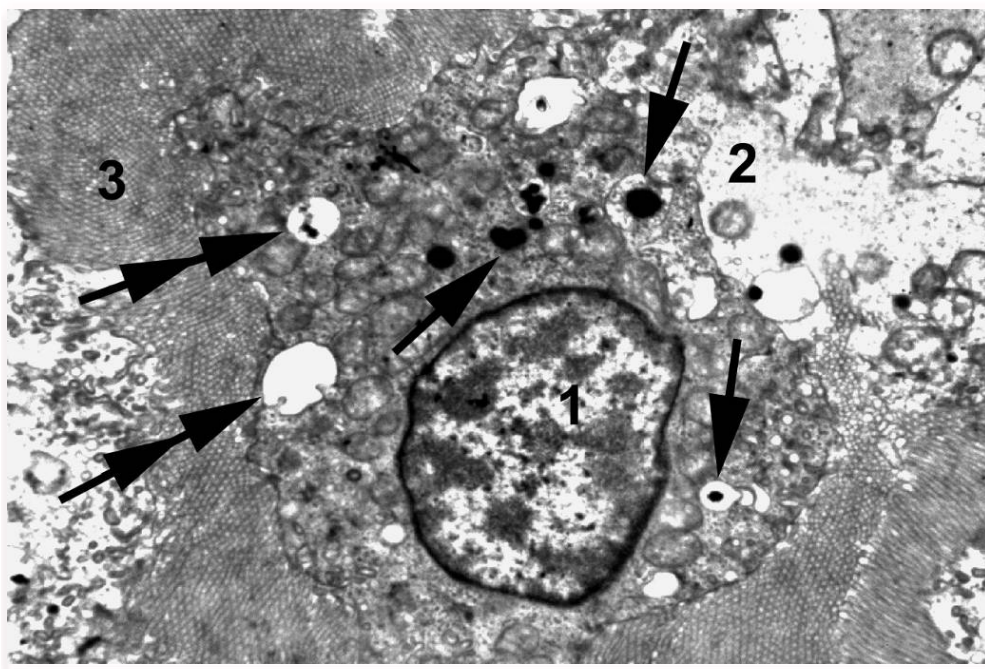


Fig. 4. An epithelial cell with the signs of an excessive areal autophagic vacuolization in the lumen of proximal convoluted tubule of the nephron in the renal medulla of a rat with skin burn injury which was given gekoton solution during 7 days after the beginning of the experiment, 14 days after the beginning of the experiment. Mitophagosomes are indicated with single arrows; autophagic vacuoles are indicated with double arrows. 1 – nucleus of an epithelial cell; 2 – fusion area of vacuoles and mitophagosomes with formation of a locus of partial necrosis; 3 –microvilli of limbic penicillatus. $\times 8000$.

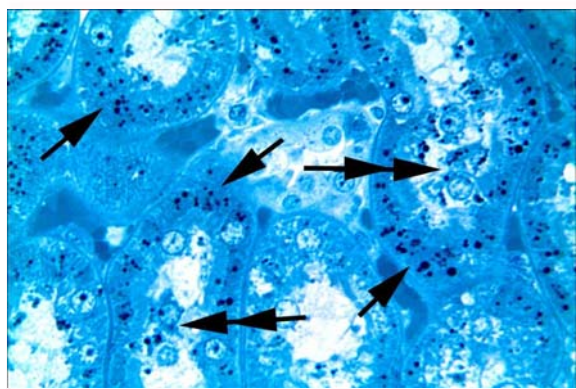


Fig. 5 Numerous clumps of mitophagosomes in the cytoplasm of epithelial cells of tubular wall (they are indicated with single arrows) and in the cytoplasm of destroyed epithelial cells (they are indicated with double arrows) in the tubular lumen in the renal medulla of a rat with skin burn injury which was given gekoton solution during 7 days after the beginning of the experiment, 14 days after the beginning of the experiment. Semifine section. Dying with methylene blue and azure II. $\times 400$.

If the first kind of mitochondria death is certainly pathological, mitophagy has an adaptive nature as a factor of mitochondria renovation and a factor of suppression of mitochondrial transduction of apoptotic

signal [9]. There are certain dynamics in progress of mitophagy which achieve their peak level 14 days after the skin burn and becomes redundant or even excessive. Increase of mitophagolysosomes number and their intensive transformation into autophagic vacuoles which ends in a massive autophagic vacuolization of the cytoplasm of some epithelial cells is considered a sign of an excessive mitophagy. Such vacuolization (the vacuole's contents are removed out of the cytoplasm) results in formation of numerous defects of cytomembrane (the consequence of «vacuolar explosion»), cell disruption by type of necrosis and desquamation of the latter into the tubular lumen.

Conclusions

1. In case of an experimental skin burn of II-III grade of 21-23 % of body surface area in rats a remarkable cytoprotective effect of gekoton on the structure of the renal medulla is a morphologic equivalent of positive effect of an intravenous infusion of gekoton. The above-mentioned cytoprotective effect is caused by the induction of mitochondria hypertrophy and hyperplasia, as well as the stimulation of mitophagy which provides the removal of damaged mitochondria and suppresses the progress of cell apoptosis.

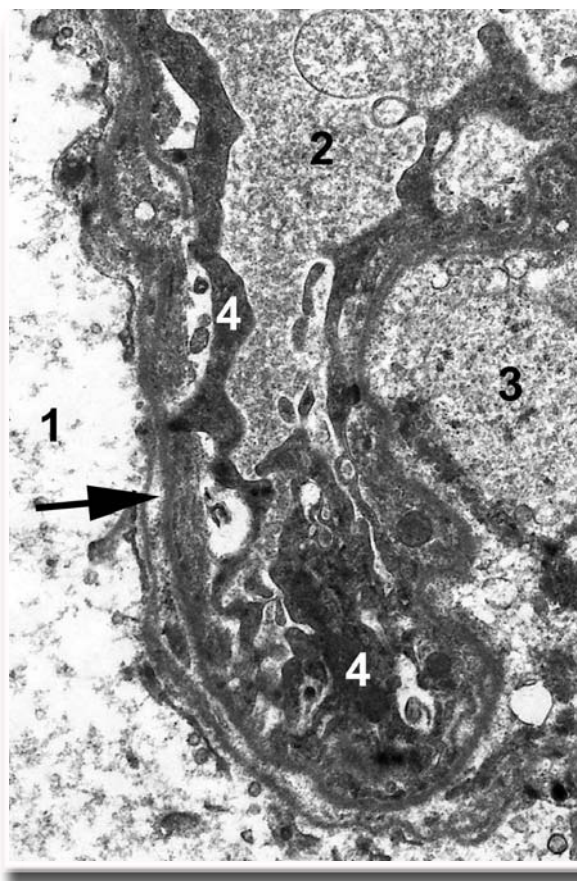


Fig. 6. Irregular reduction of hyperosmotic cytoplasm areas, their clasmatosis, subtotal peeling of deformed and fragmented hyperosmic cells off the basement membrane of the nephron thin tubule in the renal medulla of a rat with skin burn injury which was given gekoton solution during 7 days after the experiment had begun, 21 days after the beginning of the experiment. Tubular basement membrane is indicated with an arrow. 1 – paravasal edema; 2 – tubular lumen; 3 – paravasal cell debris; 4 – cytoplasm of an epithelial cell. $\times 10000$.

2. During 30 days of structural modifications progress in the renal medulla in rats which were given the solution gekoton, the mitophagy in the cytoplasm of epithelial cells of renal tubules had been

characterized with full timely dynamics. The mitophagy reaches its peak within 14 days after skin burn and it becomes redundant or even excessive. A sign of mitophagy excessiveness is an increase of number of mitophagolysosomes and their intensive transformation into autophagic vacuoles, which finishes with a massive autophagic vacuolization of some epithelial cells the cytoplasm. Such vacuolization (the vacuole's contents are removed out of the cytoplasm) results in formation of numerous defects of cytomembrane (a consequence of "vacuole explosion"), cell disruption by type of necrosis and its desquamation into the tubular lumen.

3. Within a long period of time after the last administration of gekoton (21 and 30 days after skin burn, that means, 14 and 23 days after the last infusion) we have not noted the mitophagy in the cells of the renal medulla in rats with burns. Instead of it, the peeling of the deformed hyperosmotic cells off the basement membrane is observed, what morphologically corresponds to a kind of classical apoptosis, that means, to anoikis.

4. The comparison of terms of mytophagy progress, as well as the induction of mitochondria hypertrophy and hyperplasia in the cells of the renal medulla in rats given gekoton, with the terms of progress of anoikis allows us to suppose that during a certain period of time (21 and 30 days after the skin burn) an unblocking of mitochondrial transduction of apoptotic signal is performed. These data are not only a morphologic sign of cytoprotective effect of gekoton, but also an evidence of the existence of a period of time for an optimal cytoprotective effect of the drug in case of its short – time (a daily injection during the first 7 days) administration.

Perspective of further studies consider that the obtained results are a peculiar control and they are necessary for an interpretation in comparison with the data which are to be obtained during the investigation of the modifications of structural components of the renal medulla under conditions of an infusion of other combined hyperosmolar solutions.

References

1. Kozynets VP, Slesarenko SV, Sorokina OM. [Burn trauma and its consequences]. Dnipropetrovsk: Presa Ukrayiny; 2008. 224 p. Ukrainian.
2. Gunas IV, Kondratskiy BO, Nurmetova IK. [Dynamics of endogenous intoxication changes in the body of rats within a month after skin burning of II-III degrees with area of 21-23% of the body surface and their correction by infusion solutions of lactic proteins with sorbitol and HAES-LX-5 %]. *Ukrainskiy morfologichniy almanakh*. 2012;10(4):29-34. Ukrainian.
3. Dzevulska IV, Gunas IV, Cherkasov EV. [Morphological characteristics of histohematological barriers in the organs of the neuroiminic endocrine system during infusion therapy of burn disease by combined hyperosmolar solutions]. *Khirurgiya, Vostochnaya Evropa*. 2014;2(10):113-24. Russian.
4. Cherkasov VG. [Ultrastructural transformation of intercellular substance in internal organs in the treatment of burn disease by infusion of combined hyperosmolar solutions]. *Klinichna anatomiya ta operativna khirurgiya*. 2015;1(51):37-44. Ukrainian.
5. Cherkasov EV. (2012). [Selectivity of autophagy in thymus epithelioectulosis and its role in cell survival and cell death in thymus with burn disease]. *Naukoviy visnyk Uzhgorodskogo Universitetu*. 2012; 43, 122–126. Ukrainian.

6. Kondratskiy BO, Novak BL. [Complex hyperosmolytic colloid-infusion drug]. 2011; Patent 93776, Ukraine, MPK A61K9/08, (5), 12. Ukrainian.

7. Tolkovsky AM. [Mitophagy]. Biophys. Acta. 2009;1793:1508-15. Russian.

8. Shen DF, Noris KL, Youle R. Mitochondrial

dynamics and apoptosis. Gens Dev. 2008;22(12):1577-90.

9. Kroemer G, Galluzzi L, Vandenabeele P. Classification of cell death: recommendation of the Nomenclature Committee on the Cell Death. Cell Death Differ. 2009;16:1-3.

Ковальчук О.І., Черкасов В.Г., Пастухова В.А., Маліков О.В. Морфологічний стан мозкової речовини нирки щурів при експериментальній опіковій травмі шкіри за умов застосування інфузії гекотону.

РЕФЕРАТ. Передумови. Актуальність даної роботи обумовлена тим, що в даний час аналіз показників структурних змін мозкової речовини нирки в разі опікової хвороби в умовах терапії інфузією колоїдних гіперосмолярних розчинів не представлений як самостійний предмет дослідження. Стаття присвячена структурним змінам мозкової речовини нирки щурів при експериментальній травмі шкіри в умовах внутрішньовенної інфузії колоїдно-гіперосмолярним розчином гекотону. Встановлено, що гекотон діє як цитопротектор. **Мета.** Дослідження структурних змін мозкової речовини нирки у разі експериментальної травми шкіри щурів за умов внутрішньовенного введення гекотону. **Методи.** Макроскопічні, гістологічні, електронно-мікроскопічні, лабораторні, статистичного аналізу. Експериментальне дослідження морфологічних змін мозкової речовини нирки при опіковій хворобі (протягом 1, 3, 7, 14, 21, 30 днів) за умов впливу 0,9% розчину NaCl і інфузії колоїдних гіперосмолярних препаратів з детоксикаційним, реологічним, енергетичним, протишоковим ефектом гекотона було проведено на 90 щурах-самцях лінії Wistar вагою 155-160 г. **Результати.** Зміни мікроциркуляції та руйнування цитоплазми епітеліальних клітин апікального відділу проксимальних звивистих каналців нефрону характерні для мозкової речовини нирки щурів з опіком шкіри, які отримували розчин гекотону протягом перших трьох днів після початку експерименту. **Висновок.** При експериментальному опіку шкіри II-III ступеня площею 21-23% поверхні тіла щурів після введення гекотону визначається позитивний цитопротекторний ефект на мозкову речовину нирки, що є морфологічним еквівалентом позитивного ефекту внутрішньовенного введення гекотону. Вищезгаданий цитопротекторний ефект обумовлений індукцією гіпертрофії мітохондрій та гіперплазії, а також стимуляцією мітофагії, яка забезпечує видалення пошкоджених мітохондрій та пригнічує розвиток апоптозу клітин.

Ключові слова: опік, мозкова речовина нирки, світлова та електронна мікроскопія.

Ковальчук А.И., Черкасов В.Г., Пастухова В.А., Маликов А.В. Морфологическое состояние мозгового вещества почек крыс при экспериментальной ожоговой травме кожи при условии применения инфузии гекотона.

РЕФЕРАТ. Предпосылки. Актуальность данной работы обусловлена тем, что в настоящее время анализ показателей структурных изменений мозгового вещества почки в случае ожоговой болезни в условиях терапии инфузией коллоидных гиперосмолярных растворов не представлен как самостоятельный предмет исследования. Статья посвящена структурным изменениям мозгового вещества почки крыс при экспериментальной травме кожи в условиях внутривенной инфузии коллоидно-гиперосмолярным раствором гекотона. **Цель.** Исследование структурных изменений мозгового вещества почки при экспериментальной травме кожи крыс в условиях введения гекотона. **Методы.** Макроскопические, гистологические, электронно-микроскопические, лабораторные, статистического анализа. Экспериментальное исследование морфологических изменений мозгового вещества почки при ожоговой болезни (в течение 1, 3, 7, 14, 21, 30 дней) в условиях воздействия 0,9% раствора NaCl и инфузии коллоидных гиперосмолярных препаратов с детоксикационным, реологическим, энергетическим, противошоковым эффектом гекотона было проведено на 90 крысах-самцах линии Wistar весом 155-160 г. **Результаты.** Изменение микроциркуляции и разрушение цитоплазмы эпителиальных клеток апикального отдела проксимальных канальцев нефрона характерные для мозгового вещества почки крыс с ожогом кожи, которые получали раствор гекотона в течение первых трех дней после начала эксперимента. **Вывод.** При экспериментальном ожоге кожи II-III степени площадью 21-23% поверхности тела крыс после введения гекотона определяется положительный цитопротекторный эффект на мозговое вещество почки, что является морфологическим эквивалентом положительного эффекта после введения гекотона. Вышеупомянутый цитопротекторный эффект обусловлен индукцией гипертрофии митохондрий и гиперплазии, а также стимуляцией митофагии, которая обеспечивает удаление поврежденных митохондрий и подавляет развитие апоптоза клеток.

Ключевые слова: ожог, мозговое вещество почки, световая и электронная микроскопия.