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Реферати

ВИВЧЕННЯ ВПЛИВУ ВІТАМІННО-МІНЕРАЛЬНОГО КОМПЛЕКСУ, ЩО МІСТИТЬ ЦИНК L-АСПАРАГІНАТ, НА СТАН ПАРОДОНТА ЩУРІВ В УМОВАХ МОДЕЛЮВАННЯ ПАРОДОНТИТУ

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Метою дослідження було вивчення впливу вітамінно-мінерального комплексу, що містить цинк L-аспарагінат, на стан тканин пародонта щурів в умовах моделювання пародонтиту за допомогою екзогенної колагенази. Вітамінно-мінеральний комплекс, що містить цинк L-аспарагінат, мало позитивний вплив більшою мірою на кісткову тканину пародонту. Комплекс проявив пародонтопротекторні, протизапальні, антиоксидантні властивості.

Ключові слова: цинк L-аспарагінат, моделювання пародонтиту, колагеназа, колаген, глікозаміноглікани, ясна, кісткова тканина пародонту, щури.

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ИЗУЧЕНИЕ ВЛИЯНИЯ ВИТАМИННО-МИНЕРАЛЬНОГО КОМПЛЕКСА, СОДЕРЖАЩЕГО ЦИНК L-АСПАРАГИНАТ, НА СОСТОЯНИЕ ПАРОДОНТА КРЫС В УСЛОВИЯХ МОДЕЛИРОВАНИЯ ПАРОДОНТИТА

Шнайдер С.А., Балега М.И., Зомбор Е.В., Семенов Е.И., Ткаченко Е.К.

Целью исследования явилось изучение влияния витаминно-минерального комплекса, содержащего цинк L-аспарагинат, на состояние тканей пародонта крыс в условиях моделирования пародонтита с помощью экзогенной коллагеназы. Витаминно-минеральный комплекс, содержащий цинк L-аспарагинат, оказал положительное влияние в большей степени на костную ткань пародонта. Комплекс проявил пародонтопротекторные, противовоспалительные, антиоксидантные свойства.

Ключевые слова: цинк L-аспарагинат, моделирование пародонтита, коллагеназа, коллаген, гликозаминогликаны, десна, костная ткань пародонта, крысы.

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EFFECT OF HORMONE-ACTIVE METABOLITES OF CHOLECALCIFEROL ON THE STATE OF THE ORAL CAVITY TISSUES IN RATS UNDER THE CONDITIONS OF ESTROGEN DEFICIENCY AND TRAUMATIC STRESS

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The purpose of the study was to comparatively establish the effect of active metabolites of vitamin D_3 on the periodontal condition of rats under conditions of experimental estrogen deficiency and traumatic stress. The experiment was carried out on 31 female breeding Wistar rats. 1st group was intact one (8 animals). The rats of the 2nd - 4th groups underwent ovariectomy and a f□m□r□l fr□□tur□. Gr□u□ 2 w□s □□ntr□l □n□ (8 r□ts); r□ts □f th□ 3rd □nd 4th gr□u□s r□□□v□d □r □s □r□□r□t□□ns □g□nst th□ background of the pathogenic effect: Group 3 (8 rats) – 1-α-hydroxycholecalciferol at a dose of 0.1 μg □r d□ □□r r□t; □n th□Gr□u□ 4 (7 rats) – 24,25-hydroxycholecalciferol at a dose of 1.25 μg per day/rat. At the time of sacrifice, the animals were 15 months old. Under the influence of risk factors for periodontitis, protective properties of hormone-active metabolites of vitamin D_3 were observed. They were expressed in inhibition of lipid peroxidation processes in the oral mucosa of rats, as well as periodontal protective effects when using 24,25-hydroxycholecalciferol.

Key words: vitamin D_3 metabolites, estrogen deficiency, traumatic stress, periodontal protection properties, antioxidant effect, rats.

The study is a fragment of the research project "The effect of hypoxia on the processes of collagen formation and mineralization in models of dental pathology and correction of these disorders", state registration No. 0118U006963.

Vitamin D_3 or cholecalciferol, which realizes its action in the organism through active metabolites – $25OHD_3$, $1,25(OH)_2D_3$ and $24,25(OH)_2D_3$, is directly involved in the bone tissue metabolism. $1,25(OH)_2D_3$ or calcitriol, is the most biologically active metabolite of vitamin D_3. With a deficiency of calcium and phosphorus, the metabolism of $25OHD_3$ follows the formation of 1,25 $(OH)_2D_3$, which is catalyzed by the enzyme 1-α-hydroxylase, which is present in the mitochondria of renal tubular epithelial cells. With an increased or normal concentration of calcium and phosphorus in the blood serum, an alternative metabolite, $25OHD_3$ – $24,25(OH)_2D_3$, is formed with 24-hydroxylase [10]. The fundamental

difference in the effects of 1.25 $(OH)_2D_3$ from 24,25 $(OH)_2D_3$ consists in the fact that in the first place is its resorption effect on the bone. At the same time, both metabolites have practically the same activity in relation to the absorption of calcium in the intestine. 24,25$(OH)_2D_3$ effects under physiological conditions, it ensures the calcium absorption in the intestine and utilization in the processes of mineralization and osteogenesis of bone tissue.

Recently, it has been shown that vitamin D_3 can affect the functioning of many organs and body systems. In addition to the well-known vitamin D_3 participation in the regulation of calcium and phosphorus metabolism and related effects in the processes of bone tissue remodeling, vitamin D_3 also has an immunomodulatory, anti-inflammatory, antiproliferative effect and is able to prevent tumor cell transformation [5]. Molecular mechanisms that provide the cytoprotective properties of vitamin D_3 can be realized both through genomic regulation, which mechanism mainly corresponds to the steroid hormone effects, and through non-genomic effects, including its influence on the expression of signaling proteins, cellular metabolism, inflammatory processes, and oxidative stress [11].

Vitamin D_3 is critical for the functioning of a wide variety of organ systems, and its deficiency contributes not only to low bone mineral density, osteoporosis, osteopenia, but also to infectious and chronic inflammatory diseases. It was found that the manifestations of systemic osteoporosis include an increase in atrophic processes in the jaw bones. A decrease in the level of 1.25 $(OH)_2D_3$ in postmenopausal women plays an important role in the development of osteoporosis. The activity of 1-α-hydroxylase is influenced by the level of estrogen.

In periodontitis, osteoclastic resorption of periodontal bone tissue increases, which is associated in the post-menopausal period in women with insufficient estrogen synthesis.

Among the synthetic analogs of 1.25 $(OH)_2D_3$, 1αOND_3 ("Oxydevit", LLC "RPK EKHO", RF) is of the greatest importance. This form of vitamin D_3 has the same spectrum of action as 1.25 $(OH)_2D_3$. Its high biological activity is explained by the conversion to 1.25 $(OH)_2D_3$ as a result of hydroxylation involving 25OH. 1αOHD_3 has a more prolonged and “mild” effect.

The purpose of the study was to comparatively establish the effect of main active metabolites of cholecalciferol on the periodontal condition of rats under conditions of experimental estrogen deficiency and bone injury.

Materials and methods. The experiment was carried out on 31 female breeding Wistar rats. Group 1 (8 animals) consisted of intact rats. At 2 months of age, the rats of Groups 2-4 underwent ovariectomy, as well as a femoral fracture of one of the hind limbs 1 month before sacrifice. Group 2 (control) consisted of 8 rats (ovariectomy+fracture). Rats of the 3rd and 4th groups, starting from the next day at 2 months of age, were given per os preparations: the 3rd group (8 rats) – 1αOHD_3 at a dose of 0.1 μg day/rat; in Group 4, 7 rats were injected with 24,25$(OH)_2D_3$ at a dose of 1.25 μg day/rat (LLC "RPK EKHO", RF). At the end of the experiment, the rats were sacrificed by total exsanguination from the vessels of the heart under anesthesia with thiopental (40 mg/kg). All experiments were carried out in accordance with the European Convention for the Protection of Vertebrate Animals used for Experimental or other Scientific Purposes (Strasbourg, 1986). Having previously separated the oral mucosa and submandibular salivary glands, maxilla and mandible were isolated. Resorption of the alveolar bone was assessed on freshly isolated jaws.

The objects of biochemical studies were the oral mucosa, submandibular salivary glands, alveolar bone, liver, femoral muscle, femur. The lipid peroxidation level (LPL) was assessed by the content of diene conjugates (DC) [4] and malondialdehyde (MDA). The activity of antioxidant enzymes was determined: glutathione reductase (GR) [8] and glutathione peroxidase (GPx) [12], as well as the state of the thiol-disulfide system [9]. In the liver, the content of DNA and RNA was determined [1]. The content of polyenoic fatty acids was determined in liver lipids by gas-liquid chromatography.

The experimental results were processed by conventional statistical methods with the determination of t-criteria for the reliability of differences according to Student's t-test.

Results of the study and their discussion. The study on the effect of the hormonal forms of cholecalciferol 1αOHD_3 and 24,25$(OH)_2D_3$ was carried out against the background of experimental ovariectomy in combination with traumatic stress of a femoral fracture (control group).

Morphometric studies of the alveolar process bone in rats showed that the experimental pathogenic effect did not significantly change the parameters of bone resorption of the periodontal bone (table 1).

Experimental ovariectomy performed in rats in combination with a femoral fracture significantly increased the level of diene conjugates in the liver by 5.4 times ($p < 0.001$) compared to the intact group, which indicates the intensification of LPL processes in this study object (Table 1). In the bone of the alveolar bone and in the femoral muscle, the increase in the level of the primary LPL products, diene conjugates, was not significant (3% and 52%, respectively, Table 2). In the control group, the activity of glutathione peroxidase in the liver increased by 1.5 times ($p = 0.05$) compared to the intact group, which

was apparently inductive in response to an increase in the amount of LPL products in this study object. In the femoral muscle, the activity of glutathione peroxidase was not significantly changed; glutathione reductase decreased by 25% (p = 0.07), which indicated insufficient functioning of glutathione metabolism enzymes in this study object (table 2).

LPL indices and the activity of glutathione metabolism enzymes were studied in the oral mucosa and submandibular salivary glands (Table 3). Thus, the MDA content in the control group is increased by 54% in comparison with the intact group (p <0.001); in the submandibular salivary glands – by 81% (p <0.001). The activity of glutathione peroxidase in the oral mucosa increased by 1.4 times (p <0.001). Glutathione reductase activity did not change significantly (table 3). The study of nucleic acids content in the liver under conditions of ovariectomy and bone injury revealed the following: the level of DNA decreased by 5.6 times (p <0.001); RNA – by 2.9 times (p <0.001; Table 4). Experimental estrogen deficiency in combination with a traumatic fracture of the femur caused significant changes in the liver of rats in its fatty acid composition. Thus, the content of arachidonic acid (20:4) significantly decreased in liver lipids (by 66%; p = 0.001): 7.81±0.62% versus 11.7±1.0% in the intact group. The level of eicosapentaenoic acid (20:5) in the control group decreased by 65% (trend; p = 0.10): 1.21±0.18% versus 1.86±0.33%. The content of docosahexaenoic acid (22:6) significantly decreased by 67% (p = 0.011): 4.61±0.25% versus 6.90±0.65% in the intact group.

Morphometric study of periodontal bone resorption showed that 1αOHD$_3$ did not significantly affect, and 24,25 (OH)$_2$D$_3$ reduced the alveolar bone resorption in rats by 12% (trend; p_1 = 0.08; 100% in the control group; table 1).

Table 1

The effect of vitamin D$_3$ metabolites on the resorption parameters (%) of the alveolar bone in rats (M±m; p_1)

Studied index	Groups of animals			
	1	2	3	4
Alveolar bone resorption (%) (mean values)	43.0±1.5	43.5±1.6	42.4±1.1	38.2±2.3 p_1=0.08

Notes. In table 1, the reliability index p is calculated in comparison with the control group ("ovariectomy+fracture")

Of the two studied hormonal forms of vitamin D$_3$, 24,25 (OH)$_2$D$_3$ significantly reduced (p <0.001) the level of the primary LPL products – diene conjugates in the liver of rats and doubled (p_1 <0.001) the activity of glutathione peroxidase, which indicates an overall positive effects on the organism of rats (table 2). The content of diene conjugates in the femoral muscle decreased to a greater extent 1αOHD$_3$ than 24,25(OH)$_2$D$_3$ (Table 2). 1αOHD$_3$ increased the activity of glutathione peroxidase by 55% (p_1 <0.001). 24,25 (OH)$_2$D$_3$ increased the activity of glutathione reductase by 17% (p_1 <0.002; table 2).

Table 2

The effect of vitamin D$_3$ metabolites on the LPL state and the activity of antioxidant enzymes in rats' tissues (M±m; p; $_p$1)

Studied index	Groups of animals			
	2	3		4
Content: DC (extinction units/g)	liver			
	0.37±0.13	2.00±0.010 p<0.001	1.86±0.11	0.16±0.090 p_1<0.001
Activity: GR (nmol/s.g.)	0.42±0.13	0.47±0.099	1.43±0.90	–
GPx (nmol/s.g.)	8.10±0.92	12.5±2.20	14.0±3.86	26.6±0.64 p_1<0.001
	femoral muscle			
Content: DC (extinction units/g)	0.33±0.11	0.50±0.14	0.054±0.015 p_1 = 0.006	0.17±0.049 p_1 = 0.04
Activity: GR (nmol/s.g.)	3.90±0.48	2.91±0.12 p=0.07	1.25±0.23 p_1 < 0.001	3.41±0.013 p_1 = 0.002
GPx (nmol/s.g.)	12.6±0.83	13.3±0.46	20.6±1.012 p_1 < 0.001	13.2±5.61
	alveolar bone			
Kinetics of MDA accumulation (%) 1st hour of incubation	114±2.7	117±4.7	124±3.8	134±99.2
2nd hour of incubation	121±2.4	129±4.2	162±55.1	145±9.3
	femoral bone			
Kinetics of MDA accumulation (%) 1st hour of incubation	-	127±5.9	178±7.5 p_1 < 0.001	100±0.00 p_1 = 0.001
2nd hour of incubation	-	147±8.2	165±0.00 p_1 = 0.05	175±23.4

Notes. In tables 2-5, the reliability index p was calculated in comparison with the intact group; p_1 –compared to the control ("ovariectomy+fracture")

The parameters of the kinetics of MDA accumulation under the influence of the studied drugs in the femur underwent significant changes (table 2). So, if $1\alpha OHD_3$ increased the kinetics of MDA accumulation during 1- and 2-hours incubation, then 24,25-dioxycholecalciferol decreased this index by 21% even after 1-hour incubation ($p_1 = 0.001$). Hormone-active forms of cholecalciferol under these experimental conditions did not significantly change the kinetics of MDA accumulation in the alveolar bone (table 2).

Table 3

The effect of vitamin D_3 metabolites on the LPL state and the activity of antioxidant enzymes in rats' oral tissues (M±m; p; $_p$1)

Studied indices	Groups of animals			
	1	2	3	4
	oral mucosa			
Content: MDA (μmol/g)	0.041±0.0010	0.063±0.0056 p=0.001	0.035±0.0075 $p_1 = 0.011$	0.033±0.0075 $p_1 = 0.008$
Activity: GR (nmol/s.g.)	3.40±0.098	3.37±0.096	1.76±0.037 $p_1 < 0.001$	3.03±0.25
GPx (nmol/s.g.)	12.9±0.38	17.5±2.06 p=0.04	23.6±1.32 $p_1 = 0.02$	-
	submandibular salivary glands			
Content: MDA (μmol/g)	0.054±0.005	0.098±0.0038 p < 0.001	0.096±0.0052	0.10±0.018
Activity: GR (nmol/s.g.)	0.61±0.097	0.67±0.054	0.21±0.046 $p_1 < 0.001$	1.01±0.085 $p_1 = 0.005$
GPx (nmol/s.g.)	16.4±0.89	23.2±1.03 p < 0.001	27.8±0.79 $p_1 = 0.004$	31.1±1.01 $p_1 < 0.001$

We studied the changes in LPL indices and the activity of glutathione metabolism enzymes were studied in the oral mucosa and submandibular salivary glands (table 3). The content of MDA under the influence of $1\alpha OHD_3$ and 24.25 $(OH)_2D_3$ decreased in the oral mucosa by 1.8 and 1.9 times ($p_1 = 0.008$), respectively. Both metabolites did not significantly change the studied parameter in the submandibular salivary glands in comparison with the data of the control groups (table 3). $1\alpha OHD_3$ increased by 35% ($p_1 = 0.02$) glutathione peroxidase activity in the oral mucosa and by 14% ($p_1 = 0.004$) in the submandibular salivary glands and significantly reduced the activity of glutathione reductase in submandibular salivary glands as compared to the control groups. $24.25(OH)_2D_3$ significantly increased the activity of both glutathione metabolism enzymes in the submandibular salivary glands (table 3).

Under the influence of $1\alpha OHD_3$, the DNA content in the liver increased by 2.9 times (p_1=0.02; table 4). The RNA level increased by 3.4 times (p_1<0.001) under the influence of $1\alpha OHD_3$ and $24.25(OH)_2D_3$ compared to the control groups (table 4).

Table 4

The effect of vitamin D_3 metabolites on the content of RNA and DNA in the liver of rats (M±m; p; p_1)

Studied indices	Groups of animals			
	1	2	3	4
Content (mcg/g): DNA	151±9.90	27.1±16.0 p<0.001	79.8±11.5 $p_1 = 0.02$	54.2±11.5
RNA	151±4.30	52.1±8.70 p<0.001	179±19.5 p_1<0.001	175±20.1 p_1<0.001

The study of the fatty acid composition of liver lipids under the influence of preparations of hormonal forms of cholecalciferol revealed the following. Thus, $1\alpha OHD_3$ increased the arachidonic acid content(20:4) by 36% (p_1=0.08):10.6±1.3% vs. 7.81±0.62%; 24,25 $(OH)_2D_3$ – by 33% ($p_1 = 0.05$): 10.4±1.0% vs. 7.81±0.62% compared to the control groups. This active metabolite significantly increased the level of oleic acid (18:2) by 19% ($p_1 = 0.04$): 27.0±1.6% versus 22.7±0.9% and docosahexaenoic acid (22:6) by 25%: 5.75±0.53% versus 4.61±0.25% (trend; $p_1 = 0.08$).

Under the influence of risk factors for the periodontitis development (aging and chronic traumatic stress), the protective properties of hormonally active metabolites of vitamin D_3 were observed. They were expressed in the inhibition of LPL processes in the oral mucosa of rats, as well as periodontal protective effects when testing 24.25-dihydroxy vitamin D_3.

In the course of the studies, it was found that under the influence of risk factors for periodontitis (aging and chronic traumatic stress), LPL processes were activated both at the level of the body – in the liver, and in the tissues of the oral cavity – in the oral mucosa and submandibular salivary glands. The high biological activity of peroxidation products in biomolecules necessitates the constant functioning of a

special mechanism of antioxidant system in the cells, the most important components of which are antioxidant enzymes [3, 14].

The increase in glutathione peroxidase activity in the liver, oral mucosa and submandibular salivary glands was compensatory in response to the activation of peroxide processes in these study objects. An excess of peroxides can contribute to the oxidative destruction of not only lipids, but also proteins. It is generally accepted that the oxidative modification of proteins plays a key role in the molecular mechanisms of oxidative stress and may be a trigger for damage to other biomolecules (DNA and RNA) of the cell. Thus, in our studies, ovariectomy with bone injury caused a significant decrease in the levels of RNA and DNA in liver cells, as well as changes in the fatty acid composition of its lipids, apparently as a result of peroxide destruction.

In our experiments, hormonal forms of vitamin D_3 – $1\alpha OHD_3$ and 24.25 $(OH)_2D_3$ were used in conditions of ovariectomy and chronic bone injury. The protective properties of the two hormonal forms were expressed in the inhibition of LPL processes in the oral mucosa, as well as in the activity of glutathione metabolism enzymes – glutathione reductase and glutathione peroxidase in the submandibular salivary glands. Both hormonal forms of vitamin D_3 increased the level of RNA, and $1\alpha OHD_3$ increased the DNA content in the liver. $24.25(OH)_2D_3$ significantly reduced the level of LPL processes in the liver and activated glutathione peroxidase, which provides protection against the damaging effects of peroxides of different nature. A decrease in resorptive processes in the periodontal bone tissue caused 24.25 $(OH)_2D_3$; in the femur – a significant decrease in LPL processes.

Insufficient anti-resorptive effect of 1α-dihydroxyvitamin D_3, as well as an increase in MDA level in the femur (in case of its fracture), on the one hand, are associated with a significant pathogenic effect, as well as the fact that metabolizing, $1\alpha OHD_3$ is converted into calcitriol gradually. At the same time, the biological activity of 1α-dihydroxyvitamin D_3 in rats and humans is only half the activity of the hormonal form of 1,25-dioxy-vitamin D_3. In the liver, some leveling of the consequences of the peroxidation syndrome was observed, in particular, a partial restoration of the fatty acid composition of liver lipids when using $1\alpha OHD_3$ and, to a greater extent, under the influence of 24,25 $(OH)_2D_3$. Thus, the most pronounced antioxidant properties in selected experimental conditions at the level of the rats' organism and in the tissues of the oral cavity were shown by 24.25-dioxy-vitamin D_3.

The data obtained confirm the presence of antioxidant activity inherent in the vitamin D_3 molecule itself [2]. It is assumed that cholecalciferol can act as a membrane antioxidant, stabilizing membranes and protecting them from LPL through interaction with their hydrophobic regions [6, 11]. According to the literature, calcitriol (1.25 $(OH)_2D_3$) can enhance the elimination of reactive oxygen and nitrogen forms, increasing the intracellular pool of reduced glutathione. In addition, the effects of vitamin D_3 may be mediated by its anti-inflammatory activity through gene transcription of numerous anti-inflammatory cytokines [12, 13].

Conclusions

1. Under conditions of ovariectomy reproduction and bone trauma LPL processes in the liver, oral mucosa and submandibular salivary glands were intensified; the levels of DNA and RNA in the liver decreased, as well as the content of arachidonic acid as a result of its peroxide destruction.

2. Hormone-active metabolites of vitamin D_3 under the influence of risk factors for periodontitis showed an antioxidant effect, and to a greater extent the metabolite 24,25-dioxycholecalciferol.

3. $24,25(OH)_2D_3$ inhibited LPL processes in the liver, femur and oral mucosa; in the submandibular salivary glands it increased the activity of glutathione peroxidase; in the liver it restored RNA, as well as the fatty acid composition of its lipids. $24,25(OH)_2D_3$ showed a periodontal protective effect.

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Реферати

ВПЛИВ ГОРМОНАЛЬНО-АКТИВНИХ МЕТАБОЛІТІВ ХОЛЕКАЛЬЦИФЕРОЛУ НА СТАН ТКАНИН РОТОВОЇ ПОРОЖНИНИ ЩУРІВ В УМОВАХ ЕСТРОГЕННОЇ НЕДОСТАТНОСТІ І ТРАВМАТИЧНОГО СТРЕСУ

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Метою дослідження було порівняльне вивчення впливу активних метаболітів вітаміну D3 на стан пародонту щурів в умовах експериментальної естрогенної недостатності та травматичного стресу. Дослідження проведено на 31 щурі-самці лінії Вістар стадного розведення. 1-я група – інтактна (8 особин). Щурам 2-й – 4-ої груп була проведена оваріектомія і перелом стегнової кістки. 2-я група – контрольна (8 щурів); щури 3-й – 4-ої груп на тлі проведеного патогенного впливу отримували препарати per os: 3-ї групи (8 щурів) – 1αOHD3 в дозі 0,1 мкг в день на щура; в 4-й групі (7 щурів) – 24,25 (OH) 2D3 в дозі 1,25 мкг в день/щура. На момент виведення з експерименту тварини знаходилися у віці 15 місяців. В умовах впливу факторів ризику пародонтиту спостерігалися захисні властивості гормонально-активних метаболітів вітаміну D3, що виразилися в гальмуванні процесів перекисного окислення ліпідів у слизовій оболонці порожнини рота щурів, а також пародонтопротекторна ефекти при застосуванні 24,25-діоксівітаміна D3.

Ключові слова: метаболіти вітаміну D3, естрогенна недостатність, травматичний стрес, пародонтопротекторні властивості, антиоксидантна дія, щури.

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ВЛИЯНИЕ ГОРМОНАЛЬНО-АКТИВНЫХ МЕТАБОЛИТОВ ХОЛЕКАЛЬЦИФЕРОЛА НА СОСТОЯНИЕ ТКАНЕЙ РОТОВОЙ ПОЛОСТИ КРЫС В УСЛОВИЯХ ЭСТРОГЕННОЙ НЕДОСТАТОЧНОСТИ И ТРАВМАТИЧЕСКОГО СТРЕССА

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Целью исследования явилось сравнительное изучение влияния активных метаболитов витамина D_3 на состояние пародонта крыс в условиях экспериментальной эстрогенной недостаточности и травматического стресса. Опыт проведен на 31 крысе-самке линии Вистар стадного разведения. 1-я группа – интактная (8 особей). Крысам 2-й – 4-ой групп были проведены овариэктомия и перелом бедренной кости. 2-я группа – контрольная (8 крыс); крысы 3-й – 4-ой групп, на фоне проведенного патогенного воздействия, получали препараты per os: 3-й группы (8 крыс) – $1\alpha OHD_3$ в дозе 0,1 мкг в день на крысу; в 4-й группе (7 крыс) – $24,25(OH)_2D_3$ в дозе 1,25 мкг в день/крысу. На момент выведения из эксперимента животные находились в возрасте 15 месяцев. В условиях воздействия факторов риска пародонтита наблюдались защитные свойства гормонально-активных метаболитов витамина D_3, выразившиеся в торможении процессов перекисного окисления липидов в слизистой оболочке полости рта крыс, а также пародонтопротекторные эффекты при применении 24,25-диоксивитамина D_3.

Ключевые слова: метаболиты витамина D_3, эстрогенная недостаточность, травматический стресс, пародонтопротекторные свойства, антиоксидантное действие, крысы.

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