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The effect of a complex of active metabolites of vitamin D_3 with vikasol on the periodontal state of rats

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Abstract

Purpose of the study. The study of the periodontoprotective properties of the complex of a mixture of active metabolites of cholecalciferol - 1,25 $(OH)_2D_3$ and 24,25$(OH)_2D_3$ with a synthetic analogue of vitamin K - vikasol in experimental periodontitis in rats.

Materials and methods The study was carried out on 18 white male rats for 1.5 months. age, divided into 3 groups. Group 1 (4 individuals) comprised intact rats. In the rats of the 2nd and 3rd groups (7 individuals each), the parodontitis model was reproduced by oral administration of a 10% solution of pelentane, and also by replacing drinking water with a 2% solution of EDTA ad libitum. In group 3, rats were injected daily with a mixture of hormonal forms of vitamin D3 (1,25 $(OH)_2D_3$ and 24,25$(OH)_2D_3$) against a background of combined effects of pelentane and EDTA. The duration of the experiment was 60 days.

Results and conclusions. It is established that the complex of a mixture of two hormonal-active forms of cholecalciferol with vikasol has significant periodontoprotective properties. The obtained data substantiate the inclusion of vitamin D_3 in the composition of perioodontoprotective agents in the treatment of periodontitis.

Key words: cholecalciferol, active metabolites of vitamin D3, vikasol, model of periodontitis, rats.

Among bioregulators, normalizing the condition of the periodontal bone tissue, a significant role is assigned to cholecalciferol (vitamin D3) and its hormonal-active forms. Vitamin D3 is hydroxylated in the living body in two stages, resulting in the formation of its main active hormonal forms - 1,25 $(OH)_2D_3$ and 24,25 $(OH)_2D_3$.

It is known that hormonal active metabolites of cholecalciferol show their optimal physiological effect when administered together, as a result of which the stimulating effect of 1,25 $(OH)_2D_3$ and 24,25 $(OH)_2D_3$ on calcium absorption in the intestine increases synergistically [1].

The kidney formed from 24,25 $(OH)_2D_3$ - 1.24.25 $(OH)_3D_3$ (1,24,25- trioxivitamin D3) can reduce the hypercalcemic, hyperphosphaemic and calcific effects of 1,25 $(OH)_2D_3$, which , probably due to its effect on the receptors 1,25 $(OH)_2D_3$ [1]. These effects can reduce the therapeutic dose of 1,25 $(OH)_2D_3$ and improve the balance of calcium without affecting the bone.

Recently, a number of factors influencing vitamin K on the metabolism of vitamin D, on the reception of its active metabolites have been established [2].

The important role of vitamin K in the metabolism of periodontal bone tissue was demonstrated by studies on the successful modeling of experimental periodontitis as a result of the action of the vitamin K - pelentana antagonist, carried out in our previous studies. Insufficiency of calcium and magnesium ions in conjunction with the introduction of the complexant EDTA (ethylene diamine tetraacetate) was a background that promotes a high rate of development of periodontal pathology.

The purpose of this study was to study the periodontoprotective properties of a mixture of active metabolites of cholecalciferol - 1,25 (OH) 2D3 and 24,25 (OH) 2D3 with a synthetic analogue of vitamin K - vikasol in experimental periodontitis in rats.

Materials and methods

The experiment was performed on 18 white male rats of the 1.5- month old Wistar herd breeding line. Group 1 (4 individuals) comprised intact rats. The experimental model of periodontitis was reproduced in rats of groups 2 and 3 (by 7 individuals) by oral administration of a vitamin K antagonist - 10% solution of pelentan (Lehiva, Czech Republic) every other day, and also by replacing drinking water with a 2% solution of the complexone ethylenediaminetetraacetate (EDTA ad libitum. In the third group of 5 rats against the combined effect of pelentane and EDTA were daily injected.

After completion of the experiment, after 60 days, the rats were sacrificed with total bloodletting from the blood vessels (thiopental sodium 40 mg / kg). The resorption of

periodontal bone tissue was assessed morphometrically [3].

The objects of biochemical studies were serum, liver, thigh bone, oral mucosa (SSR) and bone of the alveolar process.

The level of lipid peroxidation was assessed by the content of acyl hydroperoxides (AGP) [4], and malonic dialdehyde (MDA) [5]. The activity of antioxidant enzymes was evaluated: catalase [6], glutathione reductase (GR) [7], glutathione peroxidase (GPO) [8]. The state of the thiol-disulphide system in tissues was determined by the method of [9]. The content of calcium and phosphorus in the blood serum was determined by unified methods.

The results of the studies were processed by conventional methods with the determination of the t-criteria for the reliability of the differences in the Student.

Results and discussion

The results of morphometric and biochemical studies of LPO processes and antioxidant protection of periodontal and rat tissues in the simulation of experimental periodontitis are presented in our previous article.

Influence of complex of mixture of hormonal forms of vitamin D 3 with vikasol was studied under conditions of reproduced experimental periodontitis.

Morphometric studies of periodontium revealed a significant decrease in the resorption of its bone structures under the influence of the complex. Thus, reduction of bone resorption in the lower jaw was 77% (p = 0.003 1) (from 100% in the group "periodontitis model"), on the upper - 74% (p = 0.013 1; table 1).

Table 1

Influence of a complex of metabolites of vitamin D 3 with vikasol on the parameters of bone resorption of periodontal rats in the modeling of periodontitis (M ± m; p; p1)

Groups of animals	Resorption rates (%)		
	lower jaw	upper jaw	mean values
Intact	31.6 ± 2.0	28.8 ± 2.2	30.2 ± 2.1
Model of periodontitis	62.6 ± 1.3 p <0.001	40.0 ± 3.1 p = 0.013	51.3 ± 2.2 p <0.001
Model + + vikasol mixture of metabolites of vitamin D 3	48.2 ± 3.6 p 1 = 0.003	29.4 ± 1.7 p 1 = 0.013	38.8 ± 2.7 p 1 = 0.004

Note. In Table. 1 the reliability index p is calculated with respect to the intact group; p 1 - relative to the group "parodontitis model".

When biochemical research revealed that a mixture of active metabolites of vitamin D

3 with vikasol reduced the levels of LPO at the level of the body of rats. Thus, the content of AHP decreased in serum by 6.4% (trend; p = 0.11); and more significantly in the liver (by 26%, p = 0.008, Table 2). The antioxidant effects of the complex were indicated by a decrease in the MDA content in the oral mucosa (by a factor of 1.7, p = 0.003, Table 2), which reached the level of the intact group.

Table 2

The effect of a complex of vitamin metabolites D 3 with vikasol on biochemical indices in serum and tissues of rats during the modeling of periodontitis (M ± m; p)

Learned indicators	Groups of animals	
	Model of periodontitis	Model + + vikasol mixture of metabolites of vitamin D 3
	blood serum	
Contents : AGP (unit of Ext / ml)	2.02 ± 0.03	1.89 ± 0.07 p = 0.11
Activity : catalase (mcd / l)	550 ± 161	610 ± 129
Content: cal tsiya (mmol / l)	2.49 ± 0.15	2.41 ± 0.12
phosphorus (mmol / l)	0,18 ± 0,012	0,49 ± 0,12 p = 0.04
	liver	
Contents : MDA (μmol / g)	54.7 ± 0.93	40.7 ± 4.36 p = 0.008
Activity: catalase (mcd / g)	36.0 ± 5.3	46.0 ± 5.0 p = 0.18
GPO (nmol / s · g)	4.89 ± 0.79	7.63 ± 0.53 p = 0.02
	SSR	
Content: MDA (μmol / g)	64.2 ± 5.19	36.7 ± 4.51 p = 0.003
Activity: catalase (mcd / g)	55.0 ± 12.0	42.0 ± 9.4

Note. In Table. 2-4. The indicator of reliability p is calculated for the group "parodontitis model".

In the bone tissue of rats, the MDA content decreased insignificantly: in the femur - in 1,8 times (p> 0,05; table. 3); in the bone of the alveolar process - by 12% (p> 0.05; table 3). In this case, the activity of glutathione metabolism enzymes: glutathione reductase (p <0.001) and glutathione peroxidase (p = 0.011; Table 3) increased significantly in the periodontal bone tissue. The activity of glutathione peroxidase in the femoral bone did not change significantly; and the activity of glutathione reductase decreased 5-fold (p = 0.016; Table 3).

Table 3

Influence of a complex of metabolites of vitamin D 3 with vikasolom maintenance peroxide products and activities of antioxidant enzymes inrats with bone modeling periodontitis (M ± m; p)

Learned indicators	Groups of animals	
	Model of periodontitis	Model + + vikasol mixture of metabolites of vitamin D 3
	bone of the alveolar process	
Contents : MDA (μmol / g)	12.3 ± 1.27	10.8 ± 2.31
Activity : GR (nmol / s · g)	0.00	0.14 ± 0.030 p <0.001
GPO (nmol / s · g)	2.10 ± 0.53	4.21 ± 0.47 p = 0.011
	femur	
Contents : MDA (μmol / g)	14.6 ± 4.89	8.34 ± 2.04
Activity : GR (nmol / s · g)	0.24 ± 0.065	0.048 ± 0.015 p = 0.016
GPO (nmol / s · g)	4.47 ± 0.68	4.83 ± 0.74

Under the influence of the complex in the blood serum, the calcium content did not change significantly, phosphorus - increased slightly (table 2).

Table 4

The effect of a complex of vitamin metabolites D 3 with the Vikassol on the state thiol-disulphide system in the tissues of rats during the modeling of periodontitis (M ± m ; p)

Learned indicators	Groups of animals	
	Model of periodontitis	Model + + vikasol mixture of metabolites of vitamin D3
Content:	liver	
SH- groups (mmol / g)	1.63 ± 0.53	16.0 ± 0.37 p <0.001
SS- groups (mmol / g)	5.83 ± 1.06	7.16 ± 1.06
SH / SS	0.28	2.23
Content:	SSR	
SH- groups (mmol / g)	4.13 ± 0.32	3.71 ± 0.21
SS- groups (mmol / g)	4.77 ± 0.32	5.88 ± 0.05 p = 0.004
SH / SS	0.87	0.63
Content:	bone of the alveolar process	
SH- groups (mmol / g)	2.54 ± 0.21	2.55 ± 0.27
SS- groups (mmol / g)	8.28 ± 0.53	6.25 ± 0.53 p = 0.02
SH / SS	0.31	0.41

The complex of active metabolites of cholecalciferol with vikasol in the liver of animals significantly increased the content of sulfhydryl water-soluble groups of proteins that perform antioxidant functions in tissues [10]. At the same time, the ratio SH / SS was significantly increased in comparison with the control group ("parodontitis model", table 4).

In the oral mucosa, the level of disulfide compounds increased (by 23%, p = 0.004). In the bone of the alveolar process a complex of metabolites of vitamin D 3 with vikasol reduced by 25% the content of disulfide water-soluble protein groups (p = 0.02, table 4).

Conclusion

As a result of the investigations, it was established that the complex of the mixture hormonally active form of cholecalciferol with vikasolom parodont and has significant properties, which resulted in the reduction of bone resorption and periodontal and asset atsii in this research object (in contrast to the thighbone) of some links of its antioxidant defense, in particular, glutathione metabolism enzymes. The antioxidant effects of the complex were also manifested as a result of an increase in the content of sulfhydryl groups in the liver and a decrease in the level of disulfide compounds (SS groups) in the bone of the alveolar rats of rats .

The obtained data justify the inclusion of the vitamin D_3 composition of parodontoprotective agents in the treatment of periodontitis.

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