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METAL IONS

CALCIUM, MAGNESIUM, COPPER AND ZINC IONS IN THE COMPLEX PROPHYLAXIS OF GENERALIZED PARODONTITIS IN POSTMENOPAUSAL FEMALES

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ABSTRACT: Systemic osteoporosis caused by estrogen deficit affects teeth and jaws and is marked by roentgenologically confirmed reduction of the alveolar process of the mandible and clinical manifestation of inflammatory dystrofic process in the paradontium. To prevent the development of pathological changes a group of patients received daily 1.5 g of calcium perorally and additionaly they were applied electrophoresis with calcium, copper, zinc and magnesium. The results of the performed treatment were assessed by roentgenological, echoosteometric and absorbometric methods. The dynamics of oral state was assessed by means of objective methods of the study, by the determination of the hygienic indices and quantity of gingival liquid. The effect of such metallic ions as calcium, copper, zinc and magnesium on the female organism by physiotherapy methods results in the osseous tissue during the first year of the postmenopausal period.

Introduction

Systemic effect of many diseases on the bone is manifested by osteoporosis as well as by osteopenia that usually *precedes* osteoporosis. One of the most common forms of osteoporosis is a postmenopausal osteoporosis that accounts for 85% of all osteoporosis forms (Rozhinskaya, 1996). In the second half of life the main cause of surplus loss of the osseous mass is hypogonadism. Damage of the cortical bone in osteoporosis is confirmed in the studies in humans as well as in the laboratory animals (Fushimi et al.,1993). It is known that the cortical layer plays the decisive part in the osseous resistance to mechanical disturbances (Lotz et al., 1995). Comparing the obtained results in the duration of ultrasound spreading in various skeletal areas it should be noted that in generalized osteoporosis the most marked changes in the mineral density of the osseous bone (MDOB) are observed in the areas of the ulnar and radial bones and in the mandible. Osteoporotic changes in the alveolar process are observed when they are not defined in other parts of the osseous tissue. This is confirmed by the pathological changes in the parodontium. The relations of the metabolic disturbances in sex steroids with the parodontium pathology have been already *decribed* in literature (Kopeikin et al., 1995). According to the data of E.V. Udovitskaya the incidence of paradontium pathology in females with normal state of sexual glands makes up 26.6%, after the age of 30 this value already reaches 58.7%, and after 45 years old in the period of physiological climax it is 66.7%. In primary amenorrhea the average value of parodontium pathology in young females reaches 87.3%. Yu.M. Maximovskiy et al. (1991) examined females with the disturbance of the ovarian function and observed the signs of osteoporosis that were caused by estrogen deficit and were accompanied by the dystrophic processes in the paradontium. Calcium (Ca) in ionic state takes part in the regulation of the most important physiological processes that make up the basis of functional activity of most of the cells in the mammal organism. Calcium participates in the regulation of the secretion of a number of key hormones, enzymes and proteins in the mammal organism.

Adequate calcium intake results in stabilization of the mineral density of the bone in postmenopausal females (Ricci et al., 1998). In the early period of menopause the females are found to have a negative calcium balance, that is explained by the calcium loss with urine and is accompanied by sodium-dependent impairment of the renal calcium reabsorbtion and by the reduction of calcium reabsorbtion in the intestine. The dosage of 1.5 g of calcium taken at night hours results in the suppression of osseous resorption. Meta-analysis of the treatment by calcium containing preparations has shown that the loss of osseous mass in persons who received proper calcium quantity is much lower than 1% per year. In those subjects who did not take calcium preparations this value exceeds 1% ($P < 0.001$). High doses of calcium preparations (1–2 g) that allow to reach the "plato" state from the point of view of calcium balance inhibit (or cancel) the loss of bone mass in all parts of the skeleton. The alimentary deficit of some microelements can also be accompanied by the loss of osseous mass. This is also confirmed by the scientists who studied copper, zinc and magnesium deficit (Cohen et al., 1983; Freudenheim et al., 1986; Foldes et al., 1987; Angus et al., 1988; Strain, 1988; Reginster et al.,

1989; Conlan et al., 1990; Herzberg et al., 1990). Copper, zinc and magnesium in ionic state are indicated in the treatment of parodontium.

Materials and Methods

We examined 192 females from 43 to 52 years of age in the period of physiological menopause. The first control group included 40 healthy females from 25 to 30 years of age. The second group consisted of 79 females in the period of physiological menopause who underwent therapy according to the scheme given below. The third group comprised 73 females in the period of physiological menopause who did not take any osteostabibilising therapy. The patients who had some accompanying diseases that could cause secondary osteopenia and who had contraindications for physiotherapeutic examination were excluded from the study.

Treatment: Patients of the first group were daily given 1.5 g of calcium perorally during the period of 12 months after menopause. Simultaneously with calcium therapy physiotherapy treatment by calcium, copper, zinc and magnesium ions was administered. All types of electrophoresis were performed at the interval of two months.

Further we describe the technique of general calcium-electrophoresis according to Wermel. The electrode of 300 cm^2 area is placed into the interscapular space, two other electrodes of 150 cm^2 area each are placed on the *sural* region (calf of the leg). The conductors of these electrodes are connected together and linked to the terminal of the apparatus of 10 mA current. 20 sessions were performed according to these instructions. Further electrophoresis of 10% calcium gluconate was performed according to the following technique. One gingival electrode of 10 × 1 cm. size was applied on the mucous membrane of mandible from the vestibular side in such a way that the electric current lines should pass directly through the lesion focus. Sessions of 20 minutes duration were conducted during 20 days, current density was 0.3–0.5 mA/cm^2. After that electrophoresis sessions with the use of copper and zinc were performed observing some definite interval. Current density was 0.3–0.5 mA/cm^2. Using transverse direction 20 sessions were conducted during 20 days each session lasting 20 minutes. Magnesium electrophoresis was daily applied on the collar area according to Scherbak scheme. The number of excitations was 30. "Anode" electrode of 1000 cm^2 area is placed on the collar zone, the second electrodes "cathode" of 600 cm^2 area is placed on the lumbar-sacral area. The current power was dosed according to the following scheme: during the 1^{st}–2^{d} sessions 6 mA current was given for 6 minutes; during the 3^{d}–4^{th} sessions 8 mA current power was supplied for 8 minutes; during the 5^{th}–6^{th} sessions 10 mA current power was supplied for 10 minutes; during the 7^{th}–8^{th} sessions 12 mA current power was supplied for 12 minutes; during the 9^{th}–10^{th} sessions 14 mA current power was supplied for 14 minutes; since the 11^{th} sessions and further current power 16 mA was supplied for 16 minutes.

Examination was performed with the use of questioning, assessment of clinical condition of the oral cavity, determination of Schiller-Pisarev test (Svrakov iodine number), PI and PMA indices. Schiller-Pisarev test is based on the determination of glycogen content in the gingiva. Its content is highly increased in the inflammation due to the absence of epithelium keratinization. The quantity of gingival liquid was determined with use of Barer-Kocherzhinskaya technique. Gingival liquid was obtained from the frontal teeth in the mandible. To obtain objective evaluation of the skeletal state roentgenological, echoosteometric and absorbometric methods were used. The density in the osseous tissue of the mandible and the ulnaj bone were determined with the use of EOM 01–LS echoosteometer. Two ultrasound apparatus consisting of two parts, one of which is a transmitter and the second one is a receiver of ultrasound signals is applied to the examined osseous area. The distance between the apparature was 50 mm; it was divided by the value that was obtained in the result of the study. Then the velocity of ultrasound spreading in the given area was calculated in m/sec. The density of the mandible was determined at the angular area from the left and right sides, at the mandible body in the canine projection and at the chin region. The density of the ulna bone was determined in the proximal part. Mineral saturation of the forearm bones was defined with the use of one-photon absorbometry. The study duration was 30 seconds. The mineral component was defined with the use this method in the middle of diaphysis of the radial and ulnaj bones of nondominant arm.

Results and Discussion

On clinical examination of the oral cavity in postmenopausal females diagnostic signs that are characteristic of the dystrophic as well as of the inflammatory processes in the paradontium tissues were observed.

TABLE 1. INDICES OF INFLAMMATION AND THE QUANTITY LIQUID IN THE FEMALES.

Value	Studied group		
	First (control)	Second	Third
Schiller-Pisarev test (Svrakov number)	0.61 ± 0.04	1.15 ± 0.02	2.24 ± 0.06
PI index	0.297 ± 0.09	0.985 ± 0.11	4.085 ± 0.21
PMA index (%)	7.35 ± 0.02	12.92 ± 0.09	35.62 ± 0.11
Amount of gingival liquid in the front incisors region (mg)	0.26 ± 0.02	0.82 ± 0.05	2.93 ± 0.12

Dystrophic processes were characterized by the following symptoms: gingival retraction, exposed dental neck and then exposed dental root, dental pathology of non-carious origin. For patients suffering from parodontitis the typical symptom was gingival bleeding as well as symptoms that are typical for the inflammatory processes in the paradontium. The X-ray films revealed signs of the destructive inflammation of the osseous tissue in *interdental septa* and shortening of their height. The analysis of the indices of paradontium inflammation has shown that PI, PMA indices and Schiller-Pisarev tests, were higher than those in the control group ($P<0.01$) in the females who had estrogen deficit. In the females of the second group who received physiotherapeutic treatment and took calcium preparations for 12 months these indices significantly differed from the females of the third group ($P<0.05$).

Clinically the condition of the oral cavity in the females of the second group has stabilized during the first two months and did not considerably differ from the control group, inflammatory processes reduced. The state of the oral cavity in the females of the third group considerably aggravated. Compared to the initial state in 67% of the females, the rest of the females of this group have demonstrated inflamed parodontium of various severity. One of the important indices that characterized the severity of paradontium tissues inflammation is the amount of gingival liquid. As it is seen from Table 1 the content of the gingival liquid has greatly increased in the third group and significantly differed from the values of the second group because the females of this group did not undergo any therapeutic measures. It has been found that the mineral saturation of the forearm bones in the females of the control group was within the normal age values.

Before treatment mineral saturation in the females of the second and third groups was lower than normal (in physiological climax). After the course of therapy there was inconsiderable increase of the mineral saturation in the females in the second group, but at the same time the these values were considerably reduced and significantly differed from the initial values ($P<0.05$).

TABLE 2. ECHOOSTEOMETRY AND ABSORBOMETRY VALUES IN THE STUDIED GROUP.

Value	Studied group		
	First (control)	Second	Third
Velocity of ultrasound spreading along the mandible (m/sec): Area of right angle	3158 ± 6.2	3029 ± 3.6 (95,9 %)	2719 ± 3.81 (86.1 %)
Area of left angle	3121 ± 6.74	2973 ± 3.5 (95.2 %)	2607 ± 4.02 (83.5 %)
Mandible body (right side)	3195 ± 5.6	3036 ± 4.2 (94.9 %)	2782 ± 5..31 (87.1 %)
Mandible body (left side)	3159 ± 5.3	3007 ± 4.4 (95.1 %)	2769 ± 4.92 (87.5 %)
Chin	2774 ± 4.2	2675 ± 3.7 (96.4 %)	2332 ± 4.99 (84.6 %)
Along the right ulnar bone	3172 ± 6.1	2936 ± 4.1 (92.3 %)	2736 ± 3.19 (85,9 %)
Along the left ulnar bone	3127 ± 5.9	2849 ± 3.7 (91.1 %)	2734 ± 3.39 (87.4 %)
Mineral content in radius and ulnar bones (g/cm^2)	762.8 ± 3.92	711.2 ± 3.2 (93.2 %)	652.7 ± 2.19 (85.5 %)

Conclusions

It is evident that there is a certain correlation between the increase in the index of paradontium inflammation and aggravating hypogonadism in the females. The state of the osseous tissue in the mandible and ulna bone that was *judged* by the velocity of ultrasound spreading has revealed much lower values in those postmenopausal females who did not receive physiotherapy with calcium ions. The females with the deficit of estrogens were found to have diagnostic signs of osteoporosis. The key moment in osteoporosis diagnostics is the detection of systemic reduction of the osseous mass. The obtained data can be used for making prognosis in the course of paradontium treatment and its treatment. It should be advised to pay special attention to the state of teeth and oral in postmenopausal females and in the absence of contraindications physiotherapeutic treatment in the calcium, copper, zinc and magnesium ions may be used to prevent the early loss of teeth due to generalized parodontitis.

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