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RESULTS OF RESEARCH THE MINERAL CONTENS OF THE BLOOD AND THE ORAL FLUID IN PREGNANT WOMEN SUFFERING FROM PERIODONTITIS AND IRON DEFICIENCY

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Pregnancy due to its physiological course is supported by intensification of all kinds of intechanges including both macroelement and trace element ones. Metal imbalance is closely connected to the activity of some enzymes, vitamins and metallobiotics (iron, magnesium, cuprum and zink). The violation of the microelements' interchange, which have a huge bioactivity is connected with the impact on metabolism, sanguification, tissue respiration, determines its vital role in pathogenesis of many illnesses including periodontitis. As a result, providing mineral homeostasis is more special and complicated during pregnancy, especially one that is affected by iron deficiency. The research of serum mineral interchange proved that imbalance of trace elements (microelementosis) is essential component of iron deficiency, pathogenesis in pregnant women and it strengthens according to the development of generalized periodontitis. Iron and cuprum biometals deficiency, especially important during pregnancy, turned to be particularly keen. We have observed the gradual decrease of the content of biometals in serum in both groups of the survey with the development of generalized periodontitis. So, iron deficiency anemia leads to disorders of mineral homeostasis of oral fluid and blood serum, and the progression of generalized periodontitis increases the deficiency of trace elements in the these biological fluids.

Keywords: pregnant women, iron deficiency, generalized periodontitis, trace elements, blood, oral fluid.

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РЕЗУЛЬТАТИ ДОСЛІДЖЕННЯ МІНЕРАЛЬНОГО СКЛАДУ КРОВІ ТА РОТОВОЇ РІДИНИ ВАГІТНИХ ЖІНОК, ХВОРИХ НА ГЕНЕРАЛІЗОВАНИЙ ПАРОДОНТИТ, НА ТЛІ ЗАЛІЗОДЕФІЦИТНОЇ АНЕМІЇ

Вагітність, навіть за умов її фізіологічного перебігу, супроводжується посиленням усіх видів обміну, в тому числі і макро- та мікроелементного. Дисбаланс металів тісно пов'язаний з активністю деяких ензимів, вітамінів і металобіотиків (залізо, магній, мідь, цинк). Порушення метаболізму мікроелементів, висока біологічна активність яких пов'язана з впливом на обмін речовин, процеси кровотворення, тканинного дихання, визначають їх важливу роль у патогенезі низки захворювань, у тому числі і пародонтиту. У зв'язку з цим, забезпечення мінерального гомеостазу набуває особливого значення у період вагітності, особливо ускладненої залізодефіцитною анемією. Метою нашого дослідження стало вивчення мінерального та мікроелементного складу крові та ротової рідини вагітних жінок із залізодефіцитною анемією, хворих на генералізований пародонтит в залежності від ступеня важкості пародонтиту. Дослідження мінерального складу сироватки крові вагітних жінок довело, що дисбаланс мікроелементів (мікроелементоз) є важливим компонентом патогенезу залізодефіцитної анемії у вагітних, та посилюється з розвитком генералізованого пародонтиту. Отже, залізодефіцитна анемія призводить до порушень мінерального гомеостазу сироватки крові та ротової рідини, а прогресування генералізованого пародонтиту підсилює дефіцит мікроелементів у цих біологічних рідинах.

Ключові слова: вагітні жінки, залізодефіцитна анемія, генералізований пародонтит, мікроелементи, кров, ротова рідина.

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The vast majority of scientists are interested in the task of both saving the health of mother and a child and the study of the oral cavity condition during the pregnancy aiming to warn the onset of dental chronic disease. The study of dental diseases in pregnant women suffering from somatic pathology still remains topical [13].

Pregnancy is a physiological process in which there is a decrease in adaptation mechanisms, increasing the burden on biological resources, which leads to changes in the body's environment, including blood and oral fluid. Even deeper changes in the homeostasis of the oral cavity occur in the case of pathological pregnancy. The study of dental morbidity in pregnant women with somatic pathology remains relevant. This is due to many factors, in particular: the significant prevalence of periodontal disease among the population, the increasing incidence of extragenital diseases in pregnant women, the impact of infection on the pregnant woman and fetus. A common complication of pregnancy is iron deficiency anemia (IDA), which ranks first among all complications of gestation. Iron deficiency anemia is a clinical and hematological syndrome characterized by a decrease in the amount of iron in the body (blood, bone marrow and depot), which disrupts the synthesis of heme, as well as proteins containing iron (myoglobin, iron-containing tissue enzymes). Scientists consider iron deficiency anemia as a total organ pathology that leads to functional and morphological changes of all organs and tissues [8, 12].

Pregnancy due to its physiological course is supported by the intensification of all kinds of intechanges including both macroelement and trace element ones. The special requirements during the pregnancy is concerned with calcium which causes the mechanical properties and toughness of solid tissue (bones and teeth), takes part in the process of blood clotting and affects intercellular contacts largely. Metal imbalance is closely connected to the activity of some enzymes, vitamins and metallobiotics (iron, magnesium, cuprum and zink). The violation of the microelements' interchange, which have a huge bioactivity connected with the impact on metabolism, sanguification, tissue respiration, determines its vital role in pathogenesis of many illnesses including periodontitis. As a result, providing mineral homeostasis is more special and complicated during pregnancy, especially one that is affected by iron deficiency [3, 4, 9].

The purpose of the study was to explore mineral and trace elements in blood and the oral fluid of pregnant women who suffer from iron deficiency.

Materials and methods. Biochemical studies of the blood serum and the oral fluid were performed in 42 pregnant women who suffered from the generalized periodontitis at the initial and the 1st degree of development at a time when they had iron deficiency of a mild and moderate degree entering the main group. It was also performed in 34 pregnant women suffering from the initial and the 1st degree of development without pregnancy complication, who formed a comparison group.

Women's blood and saliva samples were taken simultaneously to determine biochemical parameters at the morning. Peripheral blood (5 ml) was drawn with a syringe from the ulnar vein and placed in a 10 ml glass tube. Mixed saliva (5 ml) was prepared by spitting without stimulation into an Eppendorf-type plastic microtubes before brushing, after obligatory rinsing of the mouth with distilled water. After centrifugation at 3,000 rpm for 15 minutes, the separated serum and supernatant saliva were placed in standardized 1.5 ml Eppendorf-type plastic microtubes, in which the test parameters were determined. Determination of biochemical parameters was usually performed on the day of sampling [2, 6, 10].

Quantitative determination of biometals of iron, copper, zinc and magnesium in blood serum and oral fluid using atomic absorption spectrophotometry using standard sets of reagents and control sera "Filo-Norm", "Filo-Pat" by "SpineLab" (Ukraine) on the atomic sorption spectrophotometer "Saturn-3", equipped with an electrothermal atomizer "Graphite-2" (Russia) according to the standard method described in the factory operating instructions. Mineralization was carried out until the ash was free of coal impurities [11].

Statistical processing of the study results was carried out using the Microsoft Office Excel software and the Real Statistics 2019 extension to it. We used non-parametric methods for evaluating and analyzing statistical hypotheses. Statistical processing of the obtained results was performed by calculating the arithmetic mean (M), mean deviation (б), mean error (m). The difference was considered statistically significant at $p<0.01$ [7].

Results of the study and their discussion. Findings of serum mineral interchange indices in pregnant women suffering from generalized periodontitis, at a time when there is iron deficiency, indicated the following. At the initial degree of the generalized periodontitis and mild form of iron deficiency, serum calcium levels ranged within normal limits and was 2.58±0.20 mmol/L, ($p<0.01$). With the development of iron deficiency this serum calcium index decreased to 2.32±0.13 mmol/L, ($p<0.01$) but was still at the lower limit of the physiological norm. The mean calcium content of serum in pregnant women suffering from generalized periodontitis of the initial degree including iron deficience was 2.41±0.16 mmol/L, ($p<0.01$).

With the 1st degree of the generalized periodontitis and mild degree of iron deficiency calcium content in the serum decreased below the margin of norm with the result of 2.24±0.12 mmol/L, and became by 1.2 times less than a similar index of iron deficiency at initial degree. At a moderate degree of iron deficiency, the calcium level in the serum of pregnant women was 2.12±0.10 mmol/L, ($p<0.01$). Reference

value of the calcium content of the serum in pregnant women suffering from iron deficiency during the 1st degree was at 1.1 times smaller than the initial degree of this illness with an accuracy of 2.18±0.11 mmol/L and 2.41±0.16 mmol/L, respectively, and less than the lower limits of norm. Therefore, the serum of pregnant women was observed increasing hypocalcemia with the development of the generalized periodontitis and the development of iron deficiency.

In generalized periodontitis of the initial degree and the mild degree of iron deficiency the level of serum iron was 8.24±0.46 μmol/L. With the progression of anemia, the index decreased to 7.26±0.32 mmol/L and was less than the lower limit of normal. The mean value of the serum content in generalized periodontitis at the initial degree was equal to 7.75±0.39 mmol/ L (Table 1).

Table 1.

Indices of mineral contens of serum of pregnant women who suffer from periodontitis and iron deficiency

Severity of GP	Severity of IDA	Ca (mmol/L)	Fe (μmol/L)	Cu (μmol/L)	Zn (μmol/L)	Mg (mmol/L)
GP initial degree (n=22)	Mild	2.58±0.20*	8.24±0.46*	11.32±0.98*	14.10±0.44*	0.73±0.08*
	Moderate	2.32±0.13*	7.26±0.32*	10.18±0.82*	12.21±0.50*	0.64±0.06*
	Mean value	2.41±0.16*	7.75±0.39*	10.75±0.90*	13.15±0.47*	0.68±0.07*
GP 1st degree (n=20)	Mild	2.24±0.12*	6.64±0.29*	8.24±0.64*	10.18±0.55*	0.58±0.06*
	Moderate	2.12±0.10*	5.12±0.25*	7.82±0.42*	7.64±0.62*	0.52±0.05*
	Mean value	2.18±0.11*	5.88±0.27*	8.03±0.53*	8.91±0.58*	0.55±0.05*

Note:* – significant difference in relation to the data of the main group in GP of initial and I degree ($p<0.01$);

At an mean degree of iron deficiency, the serum content decreased to 6.64±0.29 mmol/L. Iron content reference value in the serum of women with complicated pregnancy at 1st degree of the generalized periodontitis was greatly lower at 1.4 times against the same index at the generalized periodontitis at the initial degree 5.88±0.27 mmol/L and 7.75±0.39 mmol/L. Taking all this into account, it is natural that serum iron deficiency in pregnant women suffering from anemia increased with the development of inflammatory-dystrophic process during periodontitis.

In the study of cuprum content in the serum of pregnant women, patients sick with generalized periodontitis, at a time when there is iron deficiency, observed the following: at the initial degree of the generalized periodontitis and the initial degree of iron deficiency level of cuprum with a value of 11.32±0.98 mmol/L was within the physiological norm: 10.25-22.53 mmol/L. During the progression of iron deficiency the index decreased to 10.18±0.82 mmol/L. The mean value of cuprum content in the serum of pregnant women with the complicated course of pregnancy was 10.75±0.90 mmol/L. With 1st degree of generalized periodontitis and a mild form of iron deficiency, the cuprum level decreased below the limit norms to the value of 8.24±0.64 mmol/L. Reference value of cuprum content in the serum of pregnant women with generalized periodontitis of 1st degree with a digital number of 8.03±0.53 mmol/L was by 1.3 times lower, than the given value at generalized periodontitis of initial degree. Therefore, with the development of periodontitis in serum of pregnant women during iron deficiency we observed moderate hypocupremia. Zinc content in the serum of pregnant women with generalized periodontitis at the initial degree and initial degree of iron deficiency was 14.10±0.44 mmol/L. At the mean rate of anemia zinc decreased to 12.21±0.50 mmol/L. The mean value of zinc content in serum of pregnant women with complicated pregnancy at the generalized periodontitis at the initial degree was 13.15±0.47 mmol/L and was at the lower limit of a physiological norm. Another was the situation at the 1st degree of GP: the zinc content was below normal limit of 10.18±0.55 mmol/L even at the initial degree of iron deficiency, and at an mean degree of iron deficiency decreased to 7.64±0.62 mmol/L. The mean zinc content of pregnant women with 1st degree of generalized periodontitis was by 1.5 times less than in pregnant women with initial degree of generalized periodontitis.

Serum magnesium level in pregnant women at the initial degree of the generalized periodontitis with a initial degree of iron deficiency was 0.73±0.08 mmol/L. With the development of iron deficiency, the content of this element has reached the lower limit of normal value of 0.64±0.06 mmol/L. The reference value of zink in the serum of pregnant women with GP at an initial degree with anemia was 0.68±0.07 mmol/L and was within the lower margin of normal. Hypomagnesemia was observed during the 1st degree of generalized periodontitis: during mild degree of iron deficiency the index was 0.58±0.06 mmol/L, and at an mean it was 0.52±0.05 mmol/L. The mean value of magnesium in the serum of pregnant women with iron deficiency and the GP was by 1.2 times less than the value of at the GP initial degree of 0.55±0.05 mmol/L and 0.68±0.07 mmol/L, respectively. The study on mineral exchange of serum in pregnant women proved that the trace elements imbalance (microelementosis) is an important component of the pathogenesis of iron deficiency in pregnant women, and is enhanced with the development of generalized periodontitis.

The results of the studies show that with the initial degree of GP the serum calcium reference value was by 1.13 times less than in the comparison group 2.41±0.16 mmol/L. The iron level in the main group was by 2.73 times lower than in the comparison group. At the initial degree of the cuprum content in the serum in pregnant women suffering from iron deficiency it was by 2.26 times lower compared to women without pregnancy complications 10.75±0.90 mmol/L and 24.25±1.02 mmol/L, respectively. Zinc content in serum of the main group 13.15±0.47 mmol/L was by 1.46 times smaller than in the comparison group. At the initial degree of GP the magnesium content of the blood in the main group was by 1.35 times lower than in the group for comparison.

In the 1st degree of GP the mean values of mineral metabolism blood serum in the observation groups were the following: the calcium content in the comparison group was by 1.17 times larger than the main group of 2.55±0.13 mmol/L to 2.18±0.11 mmol/L). Serum iron level of people in group for comparison where it was 18.51±0.44 mmol/L also significantly exceeded by 3.15 times the same index of the main group 5.88±0.27 mmol/L. The cuprum content of the serum in the main group was by 3.66 times less than in the comparison group. The amount of zinc in the serum of the main group where it was 8.91±0.58 mmol/L was by 1.89 times lower than in the group for comparison. In the 1st degree of GP of magnesium content in pregnant women serum with iron deficiency was by 1.53 times lower than in the same period in women without pregnancy complications.

According to the studies, it can be argued that we observed significant violations of the mineral metabolism of serum in women having iron deficiency. The deficiency of iron and cuprum biometals which are extremely acute, were particularly needed during pregnancy. With the development of generalized periodontitis we observed a gradual decrease in the content of biometals in the serum of both groups of researches.

At the initial degree of the generalized periodontitis and mild severity of iron deficiency calcium index in the oral fluid was by 1.11 times higher than the same index in the 1st degree of generalized periodontitis. With the progression of iron deficiency to moderate level calcium content decreased to 1.06±0.02 mmol/L, but was by 1.1 times higher than the same index in the 1st degree of GP. Iron content in the oral fluid of the main group with initial and mild generalized periodontitis degree of iron deficiency 1.07±0.06 mmol/L was by 1.24 times higher than the similar one in the 1st degree of the GP. At the initial degree of generalized periodontitis with the progression of iron deficiency the iron content decreased to 0.96±0.04 mmol/L, but exceeded the iron content at the 1st degree of generalized periodontitis by 1.33 times. At the initial degree of the generalized periodontitis and a mild degree iron deficiency the cuprum content in the oral fluid in the main group was 0.42±0.05 mmol/L, but significantly exceeded this index in the 1st degree of the generalized periodontitis 0.26±0.04 mmol/L. With a moderate degree iron deficiency and the generalized periodontitis of the initial degree cuprum content decreased to 0.34±0.03 mmol/L, but was by 2.12 times higher than the index in the 1st degree of GP. At the initial degree of GP and mild degree of iron deficiency cuprum content in oral fluid was by 1.14 times higher than a similar number during the 1st degree of GP in people of main group (Table 2)

Table 2

Indexs of mineral contens of oral fluid in pregnant women who suffer from periodontitis and iron deficiency

Severity of GP	Severity of IDA	Ca (mmol/L)	Fe (μmol/L)	Cu (μmol/L)	Zn (μmol/L)	Mg (mmol/L)
GP initial Degree (n=22)	Mild	1.12±0.04*	1.07±0.06*	0.42±0.05*	0.18±0.03*	0.45±0.04
	Moderate	1.06±0.02*	0.96±0.04*	0.34±0.03*	0.16±0.02*	0.40±0.02*
	Mean value	1.09±0.03*	1.01±0.05*	0.38±0.04*	0.17±0.02*	0.42±0.03*
GP 1st degree (n=20)	Mild	1.01±0.03*	0.86±0.04*	0.26±0.04*	0.14±0.02*	0.37±0.02
	Moderate	0.96±0.01*	0.72±0.03*	0.16±0.02*	0.10±0.01*	0.30±0.01*
	Mean value	0.98±0.02*	0.79±0.03*	0.21±0.03*	0.12±0.01*	0.33±0.01*

Notes: * – significant difference in relation to the data of the main group in GP of initial and I degree $p<0.01$;

With the development of iron deficiency, the zinc content in the oral fluid at the initial degree of generalized periodontitis was declining, but exceeded this level at 1st degree of generalized periodontitis at 1.6 times. Dynamics of magnesium content in oral fluid with both initial degree and 1st degree of the GP tended to decrease with the development of iron deficiency, but the mean index with the initial degree of GP significantly exceeded by 1.3 times the index in the 1st degree of GP.

It can be argued that women who suffer from periodontitis and iron deficiency observed significant disorders of serum mineral metabolism, especially acute deficiency of iron and copper biometals in biological fluids, which are essential during pregnancy [1, 7, 12]. The content of calcium, iron, copper, zinc, magnesium in the serum was respectively by 1.15; 2.86; 2.86; 1.63 times lower than in women without

pregnancy complications (p<0.01). In the oral fluid of pregnant women with iron deficiency anemia, these values were also lower by 1.13, 2.6, 2.0 and 1.7 times (p<0.01), respectively, than in the comparison group. With the development of generalized periodontitis, a gradual decrease in the content of biometals in the serum and oral fluid of both study groups was observed.

The results of our research are consistent with the data of Borysenko AV, Mahomedova OM, Timokhina TA, Daalderop LA, Wieland BV, Tomsin K, Reyes L [1, 5].

As a practical recommendation, we advise for the general treatment of generalized periodontitis on the background of IDA dentists together with hematologists [12, 14, 15], it is important to prescribe ferrotherapy and combination therapy with vitamin-mineral complexes with mandatory control of these trace elements in biological fluids at the degrees of treatment regimens.

Conclusion

According to the obtained data, we can conclude that with the development of iron deficiency and generalized periodontitis there is a decrease of the content of macro and microelements in biological fluids of pregnant women. ith The serum calcium reference value was at 1.13 times less than in the comparison group 2.41±0.16 mmol/L. The iron level in the main group was by 2.73 times lower than in the comparison group. At the initial degree of the cuprum content in the serum in pregnant women suffering from iron deficiency it was by 2.26 times lower compared to women without pregnancy complications. Zinc content in serum of the main group 13.15±0.47 mmol/L was by 1.46 times smaller than in the group for comparison. The magnesium content of the blood in the main group was by 1.35 times lower than in the comparison group. In oral fluid there was a decrease in minerals and trace elements in pregnant women who suffer from periodontitis and iron deficiency.So, iron deficiency anemia leads to disorders of mineral homeostasis of oral fluid and blood serum, and the progression of generalized periodontitis increases the deficiency of trace elements in the biological fluids.

Prospects for further research will consist in studying physicochemical properties of oral fluid in pregnant women with gestational iron deficiency anemia. An interesting aspect of research is the study of markers of bone metabolism in pregnant women who suffer from periodontitis and iron deficiency.

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