DOI 10.25789/YMJ.2019.68.15

УДК 618.3-03-06:576.8.095.337/.338

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FEATURES OF TRACE ELEMENT STATUS AT ANEMIA IN PREGNANT WOMEN

A comprehensive clinical and laboratory research of 408 women from the Amur region during and after their pregnancy was carried on. The environment in the Amur region is characterized by low level of I, Se, high content of Mn, Fe, Zn and an imbalance of other trace elements. Research showed an increased amount of Cu in serum and decreased amount of Cu in blood cells. In anemia, regardless of the level of Fe, there was a decrease in Co, Se in serum and an increase in Mn in blood cells. The distinctive features of microelement status for iron deficiency anemia – an increased Mn in blood serum; for iron-saturated anemia – increased Li in serum, increased Li and Co in blood cells were determined.

Keywords: pregnant women, trace elements, anemia.

Introduction. Due to the rapid growth of the fetus and placenta in a pregnant woman's body there are numerous metabolic changes that are more apparent than in any other period of a woman's life. The mechanisms of adaptive adjustment during pregnancy naturally relate to the microelement homeostasis. The most "ancient" microelementosis is iron deficiency [2]. The main function of iron is oxygen transfer and participation in many oxidation-reduction processes. One of the consequences of Fe homeostasis disorders is iron deficiency anemia (IDA). About 41.8% of pregnant women worldwide are anaemic, half of which are iron-deficient [11]. However, anemia is a manifestation of the lack and imbalance of many micro - and macronutrients in the body, and other causes (genetic, biogeochemical, etc.) that affect the health of a mother before pregnancy, during pregnancy and full child bearing. Disorders in micronutrient status during pregnancy have long-term consequences [1, 3, 4, 6 - 9]. Despite a large number of studies on pathogenetic mechanisms, diagnosis and treatment of anemia, many questions remain unclear [10], especially the group of conditions with reduced hemoglobin and normal iron parameters. The objective of the work is to assess the trace element status in pregnant women of the Amur region depending on iron content at early stages of gestation to justify additional correction of imbalance disorders.

Materials and methods. The work is based on the results of a comprehensive clinical and laboratory research of 377 pregnant women at early gestation and 31 non pregnant women of reproductive age living in the territory (Amur region), in accordance with the current medical and economic standards [5] with informed consent to diagnostic studies.

The indicators of the content of Fe-one of the main microelementosis (ferritin and serum iron) and the level of hemoglobin (Hb), which includes the element for oxygen transport were taken as the basis of women groups formation.

Thus four groups were formed: non-pregnant women (n=31); pregnant women with normal amount of Hb (n=177) or comparison group; pregnant women with reduced amount of Hb and without Fe deficiency (n=102) – iron-saturated anemia (ISA); pregnant women with reduced amount of Hb and Fe deficiency (n=98) – iron deficiency anemia (IDA).

Determination of Hb, ferritin and serum iron was carried out by standard hardware methods. Trace element status of patients was estimated by the method of atomic-absorption analysis of serum and blood cells (Cu, Co, Mn, Se, Li) following sample preparation for spectrophotometer Hitachi Z900. Statistical processing and evaluation of the data were carried out using the software package "Statistica" (version 10), the calculation of the main descriptive characteristics, the reliability of differences and correlation relationships in groups with an accuracy of $p<0.05$.

Results and discussion. A comparative analysis of the research results of pregnant women is presented in the Table.

The content of copper (Cu) in blood serum in non-pregnant women from the Amur region was within the accepted norm (11-24 μmol/l), in blood cells with statistical fluctuations (14-24 μmol/l) 2-3 times lower. In pregnant women of the comparison group, amount of Cu in serum corresponded to the upper limit of the norm (23.49±0.62 μmol/l), but in comparison with the indicators of not pregnant women (16.43±1.71 μmol/l) the results were significantly higher ($p<0.001$). In anemic conditions of both ISA (26.27±0.755 μmol/l, $p<0.01$) and IDA (27.12±0.758 μmol/l, $p<0.001$), Cu content in serum remained 1.6-1.7 times higher. A decrease in Cu in blood cells in almost all women, including pregnant and non-pregnant, and all forms of anaemic conditions, were detected, which is a compensatory reaction of the body, first, to the implementation of increased needs associated with gestation, and secondly, the output of the element from the tissue depot, associated with low content in blood cells.

The content of cobalt (Co) involved in hematopoiesis in serum of pregnant women in the comparison group did not differ from that of non-pregnant women. A significant decrease ($p<0.001$) was detected in patients with anemia regardless of the nature of ferrodynamic at ISA – 0.17±0.021 μmol/l (1.6 times), IDA – 0.13±0.018 μmol/l (2.1 times). Blood cells showed a tendency towards increasing levels of Co in pregnant women, both in a comparison group (1.03±0.047 μmol/l) and IDA (1.12±0.091 μmol/l), and significant ($p<0.001$) increase in ISA – 1.5 times (1.45±0.128 μmol/l), which indicates a change in the relationship between the content of Co in serum and blood cells directly with anemia, especially in ISA.

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The content of trace elements in blood of pregnant women of the Amur region (s – serum, bc – blood cells)

Trace elements, (µmol/l)	Normal amount of Fe			Fe deficiency
	Non-pregnant	Pregnant		
	(n=31)	Comparison group (n=177)	ISA (n=102)	IDA (n=98)
	M ± m	M ± m	M ± m	M ± m
Cu s	16.43±1.71	23.49±0.62***	26.27±0.755**/o	27.12±0.758***/o
Cu bc	6.78±0.57	6.67±0.288	7.40±0.483	6.56±0.287
Co s	0.27±0.02	0.27±0.013	0.17±0.021***/ooo	0.13±0.018***/ooo
Co bc	0.97±0.05	1.03±0.047	1.45±0.128***/ooo	1.12±0.091
Mn s	0.26±0.02	0.30±0.018	0.37±0.045	0.43±0.073*/o
Mn bc	1.14±0.08	1.12±0.05	1.57±0.142***/ooo	1.70±0.139***/ooo
Se s	0.99±0.12	0.92±0.078	1.02±0.099	1.0±0.1
Se bc	1.52±0.19	1.66±0.22	0.55±0.081***/ooo	0.51±0.066***/ooo
Li s	0.17±0.06	0.22±0.038	0.47±0.099**/o	0.16±0.035
Li bc	1.61±0.06	1.45±0.04	1.82±0.18**/o	1.52±0.068

Note. Difference in indexes with the group of non-pregnant women* and control group o:
* - p<0.05; ** - p<0.01; *** - p<0.001; o - p<0.05; oo - p<0.01; ooo - p<0.001

The need to determine the manganese (Mn) in the blood is due to several reasons. The element stimulates hematopoietic processes; is an activator or part of the centers of a number of enzymes, including those involved in the catalytic cycle of radical oxidation; region of residence of the researched women, is characterized by a high content of Mn in the environment (in water, soil, plants). In this regard, we should expect an increased content of this element in the blood, which was confirmed by the results. The tendency to increase of Mn in serum was observed in the examined pregnant comparison group and in ISA. IDA was characterized by a significant increase in the content of the trace element by 1.7 times (0.43±0.073 µmol/l, p<0.05). In blood cells a sharp rise in the level of Mn (1.4-1.5 times) (p<0.001) was revealed both in ISA (1.57±0.142 µmol/l) and in IDA (1.70±0.139 µmol/l).

During the studies it was found that during pregnancy, the average content of essential trace element selenium (Se) in serum in all groups did not differ significantly (0.81-1.01 µmol/l) and corresponded to the lower limit of norm. It is important to determine trace elements in blood cells. The study revealed significantly low (p<0.001) Se content in ISA (0.55±0.081 µmol/l) and IDA (0.51±0.066 µmol/l) directly in blood cells relative to the comparison group (1.52±0.19 µmol/l). A clearer picture of the Se content in pregnant women (1.66±0.22 µmol/l) was due to an analysis of the percentage in each group.

There was Se deficiency in serum in 65.9% of women of the comparison group, in blood cells of 33.3% of the examined. Se deficiency in serum in ISA was found in 51.4% of pregnant women, while the deficiency in the blood cells increased to 90.3% of the examined. The same tendency continued in IDA, the number of pregnant women with Se deficiency in serum reached 59.1%, in blood cells – 90.6%.

Considering the functional characteristics of lithium (Li) in the body, it is logical to assess its status in pregnant women. A peculiarity of blood cells in women during gestation was a significant increase in Li in ISA in serum 0.47±0.099 µmol/l, (p<0.01) and in blood cells 1.82±0.18 µmol/l, (p<0.01). IDA was accompanied by unchanged status in comparison with groups of non-pregnant and comparison group during pregnancy.

The correlation of blood microelement status and ferrodynamic parameters in pregnant women was confirmed by the correlation analysis. Multidirectional bonds of Hb, ferritin and the studied elements in serum (Cu, Co, Mn, Se, Li), blood cells (Co, Mn, Se, Li) were revealed in anemic states.

Conclusion. The obtained data revealed the peculiarity of the blood trace elements level in pregnant women of the Amur region, which consisted in increasing Cu in serum and decreasing in blood corpuscles in both pregnant and non-pregnant women. Anemia, regardless of Fe level, is characterized by a decrease in Co, Se in serum and an increase in Mn in blood cells. A distinctive feature of ISA was an increase of Li in serum, of Li and Co in blood cells. A distinctive feature of DDA was an increase of Mn in serum.

The conducted studies have convincingly shown and confirmed that the anaemic states cannot be regarded as a violation of the metabolism of only iron, but the imbalance of other trace elements as consistent changes. Accommodation of pregnant women in biogeochemical province with deficiency of I, Se, excess of Mn, Fe and imbalance of other elements in the environment contributed to the development of a certain trace element status, similar to environmental features. This can be attributed to anemic state to poly/microelementosis and justify the correction of violations.

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