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Basic Micronutrient Deficiency in Anemia Found in Women of Childbearing Age

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Abstract: Globally anemia can be found in more than one-third of women and more than 40% of children under five years of age. The homeostasis of the main trace elements (Fe, Cu and Zn) is extremely important for the normal functioning of the body. The articl presents data on the conduct of a targeted study of little-studied aspects of a microelement deficiency state will, in particular, improve early diagnosis, identify possible clinical, hematological and other laboratory features, develop correction methods and principles for the prevention of copper and zinc deficiency states in such a risk group for the development of such hypomicroelementoses All of the above determines the great relevance and expediency of conducting this scientific research.

Keywords: microelement, micronutrients, zinc, copper and iron deficiency, biochemical analyzes.

Relevance. Anemia is considered a severe public health problem if the prevalence in a population is ≥40% . As of 2011, anemia posed a severe public health problem among children under five years of age in 69 of the 181 WHO member states and among women in 32 WHO member states, causing 8.8% of the global total years lived with disability, primarily in Sub-Saharan Africa. Reasons for anemia are manifold and differ by region and country depending on geographic location and thus climate, household wealth, nutrition, and sanitary conditionsOne of the proven cases in the stages of development of modern medicine is the lack of macro- and micronutrients necessary for the body due to various pathological conditions observed in the body. It is known that the human body contains 81 types of macro and microelements, which are of important functional importance for the human body. Among them there are several microelements that are vitally important, and the participation of all processes in the body depends on these microelements.

Zinc and copper trace elements are considered essential trace elements belonging to this group. But it is not taken into account that the deficiency of these microelements causes pathological processes in various organs and tissues, they are viewed from the one-sided, hemopoietic microelement point of view.The process of exchange of microelements in the human body is aimed at solving important issues, because the lack of vital elements causes the adaptive and compensatory capabilities of the organism of fertile age to increase, and the development of various pathological conditions.

Materials and methods. 238 women of fertile age between 19-44 years old were involved in the study. First, a questionnaire designed to identify hidden clinical signs of zinc, copper and iron deficiency in women was conducted. In the next stages, clinical and biochemical analyzes of blood were carried out. The amount of zinc, copper, and iron in the serum was determined by the IFA method. In this chapter of the dissertation, all methods of verification are detailed.Variational parametric and non-parametric statistical methods were used to calculate the arithmetic mean (M), mean square deviation, standard error of the average (m), relative sizes (frequency, %) of the studied indicator, the statistical value of the obtained measurements was the normality of the distribution according to the kurtosis criterion and equality of principal variances (F-Fisher's test) was studied, and error probability (R) was calculated by Student's (t) test. A confidence level of $R<0.05$ was accepted as statistically significant changes.

Based on the laboratory analysis, those involved in the study were divided into 2 groups: those with anemia and those without anemia with micronutrient deficiency:

Group 1 micronutrient deficiency with anemia, n=116

Group 2 showed deficiency of trace elements without anemia, n=233

The comparative relationship between zinc, copper and iron levels in women with polydeficiency in anemia and without anemia was studied and analyzed.

The analysis of the indicators showed that almost all indicators are much lower than the norm in micronutrient deficiency against the background of anemia, and in deficiency without anemia, although the amount of hemoglobin is normal, it was found that the micronutrient indicators are in the amount of the lower limits of the norm. The anemia that develops in this pathology is more often mild and moderate (hemoglobin median 106 g/l), the occurrence of severe anemia with a hemoglobin level of 35–50 g/l is not excluded. Anemia can be microcytic, normocytic, and macrocytic; the mean erythrocyte volume was 70–117 fl (median 99.6 fl). In copper-deficiency anemia, a reduced or normal number of reticulocytes is found in the peripheral blood, and nucleated erythroid cells can be detected.. Neutropenia in copper deficiency occurs in 65–98% of patients with hematological disorders . In 50% of patients from this group, the number of neutrophils is less than 1 x 109/l. In some patients with neutropenia, candidiasis of the skin and mucous membranes is observed.

Thrombocytopenia is found in 10-15% of patients with hematological manifestations of copper deficiency [13, 33], it is usually not severe (75-90 x 109/l), but in some cases it can be profound, when the platelet count drops to 24 x 109/l . Isolated anemia occurs, less often - pancytopenia and a combination of anemia with thrombocytopenia. Isolated cases of isolated neutropenia arising from copper deficiency are described. From the onset of symptoms to diagnosis, an average of 1.1 years passes, however, in some cases, the duration of this period is 23 years. There is a decrease in the concentration of copper and ceruloplasmin in the blood. In a study by Th. R. Halfdanarson et al. (2008) the concentration of zinc in the blood serum was increased in 33.3% of patients with copper deficiency, but only in 1 out of 40 patients, the increase in zinc was due to its excessive consumption. In 22.2% of patients, the serum zinc concentration was reduced and in 44.5% it was normal.

As mentioned above, zinc is also one of the most important elements for metabolism. Zinc reserves in the human body are small and amount to 1.5–2 g [10]. The largest amount of zinc is found in skeletal muscles, pituitary, pancreas and prostate glands, as well as in the retina; much less in the liver and kidneys. In the blood, zinc is mainly found in erythrocytes, a little in plasma and leukocytes. Zinc enters the body through the gastrointestinal tract with food, mainly absorbed in the duodenum. In addition, about 10-15% of zinc is secreted in the pancreas. Zinc is excreted from the body mainly with feces. Zinc is a component of all existing enzyme systems and is a component of more than 300 metalloenzymes involved in the metabolism of proteins, fats, carbohydrates, and nucleic acids [10]. Zinc is involved in cell growth, division and differentiation. Zinc is part of the alkaline phosphatase of bones, is associated with the calcification of the skeleton and its formation. It is extremely important for the linear growth of a person both in utero and postnatally. There is a high activity of zinc in the process of regeneration after burns and wounds. With zinc deficiency, hypogonadism, short stature, sexual infantilism, infertility, immunodeficiency, dermatitis, accelerated liver steatosis and atherosclerosis of the veins develop, there is a decrease in the synthesis of interleukins and the formation of mediators of intercellular interaction [11].

On average, the level of the essential microelement copper in the surveyed urban women of childbearing age with combined hypomicroelementosis was only 10.3 ± 0.26 μmol/l, with the reference range of this indicator from 7.8 μmol/l (min) to 13.1 μmol/l (max).

The average level of the essential microelement zinc in the blood serum of the examined urban women of childbearing age with concomitant hypomicroelementosis was 13.2 ± 0.22 μmol/L, with the reference range of this microelement from 10.3 μmol/L (min) to 15.3 μmol/L (max).

The average level of serum iron in the examined women of childbearing age -11.5 ± 0.16 μmol/l with the reference range of this indicator from 8.1 μmol/l (min) to 11.9 μmol/l (max).

Thus, the existing pronounced deficiency of essential hematopoietic trace elements copper and zinc also causes a pathological deficiency of the main hematopoietic trace element iron, which indicates their synergism in microelement metabolism. As can be seen from the presented table, the examined women of childbearing age with combined hypomicroelementosis retained the phenomenon of the prevalence of the level of zinc over iron and copper and iron over copper.

We studied new informative indicators in the examined women of childbearing age with combined hypomicroelementosis, characterizing the state of exchange of essential trace elements of copper and zinc-copper- and zinc-binding capacity of blood serum, i.e. indicators reflecting the maximum binding capacity of various components of blood serum - proteins, lipids, low molecular weight compounds of blood serum. On average, the index of the copper-binding capacity of blood serum in the examined women of childbearing age was 12.8 ± 0.12 μmol/L, with the reference range of this indicator from 9.7 μmol/L (min) to 14.8 μmol/L (max).On average, the zinc-binding capacity of blood serum in the examined women of childbearing age was 17.6 ± 0.10 μmol/l, with a reference range of this indicator from 10.7 μmol/l (min) to 14.0 μmol/l (max).

Thus, the existing pronounced deficiency of essential hematopoietic trace elements copper and zinc also causes a pathological deficiency of the main hematopoietic trace element iron, which indicates their synergism in microelement metabolism.

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