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Study of Oxidative Metabolism in the Blood of Women of Rreproductive Age with Iron Deficiency Anemia

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Abstract

In modern-day world, iron deficiency anemia (IDA) remains very high and the risk group is the women of childbearing age. It is found that in women with gestosis, the intensity of oxidative stress increases, and so it is necessary to study the metabolic symptoms of iron deficiency in women of reproductive age. Research conducted at the laboratory of the department of molecular biology and medical genetics using molecular cellular and biochemical techniques revealed an intensification of free radical oxidation of lipids in the blood of women with IDA oxidative stress.

Keywords

Iron deficiency anemia; Lipid peroxidation; Erythrocytes

Introduction

Iron deficiency anemia (IDA) is one of the most common diseases. Iron has significant influence on the mental and physical development, behavior, and performance and its deficiency is a serious problem for public health. Incidence of iron deficiency anemia is highest in infants, pregnant women and women of childbearing age. This is relevant not only in countries with low socio-economic level, but also in developed countries.

According to the World Health Organization (2002), iron deficiency anemia of varying severity affects about 4 billion people, representing more than 60% of the population [1].

The highest rates of IDA is registered in more than 51% of women of childbearing age because of the monthly blood loss and pregnancy. The frequency of anemia in pregnant women in different countries ranged from 21 to 80% in the level of hemoglobin and from 49 to 99% in the level of serum iron. The anemic state during pregnancy remains a major problem in obstetrics and as a consequence in pediatrics [1,2].

The variety of approaches to the study of problems related to the anemic state marked not only the growth of the disease, but also the ineffectiveness of traditional treatment regimens [2,3].

So far, there is no uniform classification of anemias, including during pregnancy, which is probably due to the presence of many etiologic and pathogenetic factors [4]. In women of childbearing age the most common cause of increased iron requirements is menstrual blood loss. During pregnancy the need for additional hardware (about 1,000 mg for the entire period of pregnancy) should be replenished to avoid the development of iron deficiency anemia [5]. Polimenoreya may cause reduction of iron in body and develop latent iron deficiency and consequently the iron deficiency anemia. Uterine bleeding is the greatest cause that increases the volume of blood loss in women and contributes to iron deficiency. IDA remains a serious problem in extragenital pathology in obstetrics, since the frequency of the disease is not reduced.

Thus, the main groups at risk of anemic conditions, including iron deficiency, are infants and children, teenage girls, women of childbearing age, pregnant and lactating women [5,6].

The biological significance of iron is defined by its participation in tissue respiration. Iron deficiency in pregnancy leads to hemic progressive hypoxia which in turn paves way for the subsequent development of secondary metabolic disorders [7,8].

The exclusive role of iron is determined by the important biological functions of proteins, which contain iron. The most famous iron-containing proteins include hemoglobin and myoglobin.

One of the major problems of modern obstetrics is to study the pathogenic mechanisms of preeclampsia in association with extragenital diseases, in particular, a violation of microcirculation, accompanied by the development of tissue hypoxia and metabolic changes in gestosis, compounded by a combination of the latter with anemia [8-10].

In recent years, the study of endogenous intoxication syndrome (EIS) has an important role. It is shown that endotoxemia develops when all pathological conditions associated with an increased catabolism or blockade detoxification systems of the body occur. Virtually any pathology and any unfavorable (stress) is activated by the exposure of the body processes of free radical oxidation, resulting in the accumulation of toxic substances, which relate to endotoxins. Increased serum content of the products of lipid peroxidation (LPO) and an increase in the activity of enzymes detoxify reactive oxygen species. Oxygen radicals (superoxide, hydroxyl, peroxide) formed during inflammation and possessing high reactivity speed up the process of peroxide oxidation of unsaturated fatty acids.

Degrading products of lipids (aldehydes, dialdehydes, epoxides) have a damaging effect on the different cell structures, proteins, nucleic acids, and other structures that are therefore endopatogenami. The concentration of malondialdehyde in serum reflects the activity of lipid peroxidation in the body of the patient, it is a marker of the degree of endogenous intoxication [9,10].

Similar changes were observed during pregnancy: IDA increased malondialdehyde (MDA) level significantly, which increases the level of other metabolites of lipid peroxidation.

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Indicators, μ measurement	The group apparently healthy women ($n = 20$)	Women IDA ($n = 20$)
DC, rel. μ/mol	9.53 ± 0.59	9.67 ± 0.58
CD, rel. μ/mol	4.08 ± 0.54	4.40 ± 0.48
SHO, cond. μ	0.06 ± 0.02	0.09 ± 0.01
CPR, cond. μ	0.74 ± 0.03	0.83 ± 0.02***
SVP, cond. μ	0.32 ± 0.04	0.40 ± 0.04
MDA μmol/ml	4.58 ± 0.53	8.36 ± 0.98***

*Significant differences compared to the control, $p < 0.001$;
**Reliability of differences compared to the control, $p < 0.01$;
***Significant differences compared to the control, $p < 0.05$.

Table 1: Indices of lipid peroxidation in erythrocytes in women of childbearing age with IDA, ($n = 40$)

Indicators, μ measurement	Group healthy women ($n = 20$)	Women IDA ($n = 20$)
SMP conv.	0.09 ± 0.007	0.17 ± 0.01*

*Significant differences compared to the control, $p < 0.001$.

Table 2: Indicators of middle molecules (SMP) in erythrocytes in women of childbearing age with IDA, ($n = 40$)

Recent studies have confirmed that women with preeclampsia have the increased risk of intensive oxidative stress, which is recorded on the dynamics of plasma levels of total free radical activity as well as in the increase in the concentration of lipid peroxide [11,12]. In this regard, it is important to study the metabolic symptoms of iron deficiency in women of reproductive age.

The aim of our study was to examine the state of LPO in women of childbearing age with iron deficiency anemia.

Materials and Methods

Research was conducted at the laboratory of the department of molecular biology and medical genetics. Molecular, cellular and biochemical methods of research were carried out in 40 women of childbearing age in Karaganda. These women were divided into the following groups: 1 oz – 20 healthy women, 2 g -20 women with IDA.

To assess the state of oxidative metabolism in red blood cells to carry out certain primary, secondary and end-products of lipid peroxidation and antioxidant enzymes. Diene conjugates (DC) formed at the stage of the initiation of lipid peroxidation reflect the direct changes in the phospholipids. MDA is formed in step propagatsii oxidation chain and is an indicator of oxidative degradation of lipid molecules. Determination of DC and ketodienes (KD) in erythrocytes was done by the method [13]. Determination of MDA in the erythrocytes was done on reaction with thiobarbituric acid according to the method [14].

According to the literature, the average molecule resulting from amplification of proteolysis can be adsorbed on the erythrocyte, enabling the figure to assess the degree of endogenous intoxication. The determination of middle molecules in red blood cells of women under study was done using a technique AN Kovalevsky and OE Nifanteva spectrophotometer at wavelengths of 254 nm and 280 nm [15].

Results and Discussion

The results showed that in women of childbearing age with IDA, there was a significant activation of lipid peroxidation, which we saw on the accumulation of peroxidation products in red blood cells. The dynamics of accumulation K, DC, and malondialdehyde are expressed in the increase in concentration as is shown in Table 1.

According to the study, the level of DC in the second group of women with iron deficiency anemia increased by 2%, KD by 8% of total primary products, by 11% of total secondary products and by 20% relative to that of healthy women.

The final products are full Schiff base ballast cells; this index recorded an increase of 34%, indicating a violation of the cell biological membranes. Furthermore, increase in the Schiff base confirms the tendency to chronic activation of free radical oxidation.

The mean value of MDA in women with IDA exceeds almost two times the rates among women in the control group, which indicates the activation of lipid peroxidation and MDA accumulation in erythrocytes.

Also, among women in group 2, significant increase of the average molecular weight of peptides to two times higher than the control value was observed due to the activation of intracellular proteolysis, indicating the development of endogenous intoxication. Toxic products of endogenous nature have a damaging effect on the blood cells and aggravate the course of the pathological process (Table 2).

Thus set, the intensification of free radical oxidation of lipids in the blood of women of reproductive age with IDA shows the development of oxidative stress.

Conclusion

Iron deficiency induces a range of violations of free radical oxidation, as evidenced by the increase of catabolites of lipid peroxidation and the development of endogenous intoxication to raise the average molecular weight peptides.

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