

# Effect of Ecopathogenic Factors on the Course of Pregnancy, the State of Fetuses and Newborns

Tsallagova L.V.  
 Vladikavkaz Scientific Center  
 of the Russian Academy of Sciences,  
 Vladikavkaz, Russia  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia  
 akusherstvo\_1@mail.ru

Popova L.S.  
 Vladikavkaz Scientific Center  
 of the Russian Academy of Sciences,  
 Vladikavkaz, Russia  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia

Maisuradze L.V.  
 Vladikavkaz Scientific Center  
 of the Russian Academy of Sciences,  
 Vladikavkaz, Russia  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia

Kabulova I.V.  
 Vladikavkaz Scientific Center  
 of the Russian Academy of Sciences,  
 Vladikavkaz, Russia  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia

Alborov D.K.  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia

Baroeva M D  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia

Zoloeva I A  
 North-Ossetian State Medical Academy,  
 Vladikavkaz, Russia

**Abstract – It has been established that, under the conditions of technogenic risk, the risk of the pathology of the gestation period increases, leading to the suffering of the fetus as a result of the development of placental insufficiency, an increase in perinatal losses and infant morbidity. The article presents facts about the features of the course of the gestation period, the status of fetuses and newborns under the influence of adverse environmental factors. The condition of the fetuses was determined on the basis of cardiotocography and ultrasound. In order to assess newborns, the cytokine profile and non-specific factors of body defense were studied. The positive dynamics of indicators of the state of the prenatal fetus was achieved on the inclusion in the complex of therapy of means that promote the elimination of heavy metal salts from the mother's body.**

**Key words – copathogenic factors, pregnancy, state of fetuses, newborns**

## I. INTRODUCTION

Environmental safety issues are mainly associated with the negative impact on the health of the population of industrial waste, such as lead and cadmium, which are among the harmful factors of non-ferrous metallurgy enterprises significantly increasing the risk of developing reproductive and perinatal pathology. Currently, enterprises of non-ferrous

metallurgy are the reason of the human exposure to a significant amount of metals of different toxicity and direction of action (lead, zinc, cadmium). Experimentally, information was obtained about the toxicology of each of them and the combined action of lead with other metals.

It was found that in the areas of residence with a high content of heavy metal salts, a high frequency of anemia of pregnant women, pre-eclampsia, preterm birth and pathology of the fetus and newborns was revealed [1, 2]. The toxicity of metals is determined by their ability to form biocomplexes, covalent bonds with the carbon atom in living organisms and to participate in redox reactions. In the future, the formation of biocomplexes leads to the activation of various enzymes, impaired permeability of cell membranes, etc. At the same time, in redox reactions, a change in the valence of heavy metals leads to an increase in their toxicity, increasing the ability to pass through the biological membranes of cells. Thus, salts of heavy metals (lead, cadmium) belong to the first class of toxicity, since, acting on the human body even in small quantities, they can lead to serious violations in the reproductive system, significantly increasing the risk of perinatal pathology [3–6].

In turn, the mother's immunity disorders adversely affect the fetal immune system. Most xenobiotics lead to the emergence of immunotoxic reactions: in early ontogenesis, their effect on the developing organism changes the thymus

gland and the T-cell immunity system. At later stages of ontogenesis, B-lymphocyte function dysfunction and antibody production to a greater extent occurs [7–9].

The effect of heavy metal salts on pregnancy is in significant pathological changes in the placental system. At the same time, the cause of placental insufficiency in pregnant women under conditions of high anthropogenic stress can be either a direct effect of ecopolitants on the mother-placenta-fetus system, or indirect effect as a result of toxic effects on the organs and systems of a pregnant woman [10–12].

## II. PROBLEM STATEMENT

Examination of the status of fetuses and newborns whose mothers were exposed to metal pollutants.

## III. MATERIALS AND RESEARCH METHODS

We examined 70 pregnant women (main group), who are residents in ecologically unfavorable areas of Vladikavkaz with various complications of gestation (threat of premature birth, preeclampsia, anemia of pregnant women, etc.) and 70 newborns in the first 6–12 days of life. The control group consisted of 50 pregnant women living in ecologically favorable areas of the city of Vladikavkaz.

The state of the fetus was assessed during pregnancy in the second and third trimesters using cardiotocography (CTG), ultrasound scanning (ultrasound), and a dopplerometric study of the fetoplacental blood flow. In addition, a morphological study of the placenta was performed. In the presence of a major group of obstetric pathology in pregnant women, a comparative assessment was performed after treatment.

## IV. RESULTS AND DISCUSSION

When evaluating cardiotocography data, normal values indicating the absence of fetal impairment are the following: average heart rate per minute (basal frequency) 120–160 per minute, number of fetal movements per 30 minutes, cardiac oscillations (phonocardiogram recording width fetus at rest)  $6.2 \pm 0.5$  beats/min, change in heart rate during fetal movement (myocardial reflex)  $8.2 \pm 0.4$  beats/min. Notably, the oscillations of the heart rhythm most reliably characterize life-threatening disorder. The results of cardiotocography in 50 pregnant women of the control group met the above standards. When assessing the initial data of cardiotocography (CTG) in pregnant women of the main group in the second trimester, it was found that the average heart rate of the fetus was  $137.9 \pm 2.2$  beats/min, the frequency of fetal movements in 30 minutes was  $4.2 \pm 0.7$  beats/min, cardiac oscillations were  $5.2 \pm 0.3$  beats/min, myocardial reflex was  $12.3 \pm 0.96$  beats/min.

In 83 % of cases, ultrasound data confirmed the results of CTG. Of the 70 examined pregnant women of the main group, 49 showed some signs of fetal intrauterine suffering. During the inspection, which lasted 25–30 minutes, the motor activity was sluggish in 38 fetuses and active in 21; respiratory movements were determined in 43 cases, not determined in 16; fetal tone was satisfactory in 27 cases and reduced in 32 cases; the amount of amniotic fluid was reduced in 17 cases. In addition, there were signs of chronic fetoplacental insufficiency (HFPN) (83 %) — premature maturation of the

placenta — an increase in its thickness inappropriate for the period of gestation, the presence of hyperechoic inclusions.

Therefore, CTG indices (low cardiac oscillation rates, myocardial reflex) and ultrasound results (physical activity, tone, fetal respiratory movements, placental maturity) confirmed the presence of placental insufficiency in 83% of pregnant women of the main group who were subjected to combined exposure to metal pollutants before and during pregnancy.

After therapy aimed at the treatment of obstetric pathology, which also includes measures aimed at eliminating intrauterine fetal hypoxia (curantil, glucose, solcoseryl, etc.) and the use of agents that promote the removal of heavy metal salts from the mother (polyfepam, glycine, limontar), cardiotocogram results showed that the mean fetal heart rate was  $135.7 \pm 1.5$  beats/min ( $p > 0.05$ ), the frequency of perturbations of the fetus in 30 min was  $7.2 \pm 0.8$  ( $p < 0.05$ ), the magnitude of heart oscillations was  $9.5 \pm 0.2$  beats/min ( $p < 0.05$ ), myocardial reflex was  $21.8 \pm 0.6$  beats/min ( $p < 0.05$ ).

As a result of the combined treatment of patients in the main group, the average heart rate of the fetus was  $136.4 \pm 2.3$  beats/min ( $p > 0.05$ ), the frequency of perturbations of the fetus in 30 minutes was  $7.7 \pm 0.4$  ( $p < 0.05$ ), myocardial reflex was  $19.1 \pm 1.2$  beats/min ( $p < 0.05$ ). In the third trimester, CTG was performed in 70 pregnant women of the main group, 12 of whom suffered from severe forms of preeclampsia, and the rest were moderately severe, often associated with anemia. As a result, it was found that before treatment the average heart rate of the fetus was  $139.2 \pm 1.5$  beats/min, the frequency of fetal perturbations per 30 minutes was  $5.7 \pm 0.3$ , cardiac oscillations were  $5.4 \pm 0.5$  beats/min, myocardial reflex was  $15.2 \pm 1.2$  beats/min. The biophysical profile of the fetuses was assessed as satisfactory (6 and more points) in 78 % of cases.

The results of placentography after treatment revealed that in the group of pregnant women who received complex therapy of intrauterine hypoxia of the fetus, the incidence of cysts and cyto-like inclusions significantly decreased (15.4 %). In the control group, in 4 cases out of 50, signs of I-stage placental insufficiency were observed, which was due to extragenital pathology: cardiovascular (2), pyelonephritis (1), anemia (1).

Dopplerometry indices revealed that in pregnant women of the main group (20 %), a significant decrease in vascular resistance indices was found, while in 15% of patients in this group there were biphasic curves with positive diastolic blood flow rate (mean values of SDR were  $2.75 \pm 0.3$ ; RI was  $0.71 \pm 0.17$ ; PI was  $1.5 \pm 0.66$ ), which was a prognostic sign of persisting placental insufficiency.

Thus, as a result of pathogenetically substantiated therapy in pregnant women of the main group, we noted a statistically significant ( $p < 0.01$ ) improvement in the main indicators of CTG, which characterize the condition of the fetus, normalization of the fetal biophysical profile according to ultrasound and stress-free test.

Analysis of the course of the second half of pregnancy revealed that in the patients of the main group the frequency of threatened interruption was significantly reduced and amounted to 15.2 %. In addition, against the background of

the comprehensive treatment of placental insufficiency and fetal hypoxia, reliable data were obtained on reducing the incidence of severe forms of preeclampsia. Thus, in the main group, preeclampsia was detected in 29.3 % of cases, which is comparable with the indicators in the control group, 20.6 % of cases. It should be noted that the clinical manifestations of preeclampsia in patients of the main group were detected with the least frequency and manifested in the form of mild or moderately severe forms.

The analysis of pregnancy outcomes revealed a high incidence of premature birth in pregnant women of the main group (26.9 %) compared with patients in the control group (15.8 %). At the same time, preterm labor in women in the control group was observed at gestational age of 36–37 weeks, while in the main group, preterm labor was observed at 29–30 weeks. In addition, for 15.4 % of pregnant women of the main group and 6.3 % of pregnant women of the control group the delivery was carried out by cesarean section.

The study of the characteristics of childbirth in the compared groups showed that the complicated course of the childbirth was significantly more frequently observed in pregnant women living in the zone of ecological distress. The most frequent complication was premature rupture of amniotic fluid (24.6 %). Anomalies of labor and bleeding in the afterbirth and the early postpartum period were 3.3 times more frequently observed in patients of the main group in comparison with the control group. Episio- and perineotomy were performed for 18 (27.6 %) women in the main group, while in the control group this indicator was significantly lower (15.2 %).

The complexity of the diagnosis and correction of pathological conditions associated with diselementosis, dictates the need for a more detailed study of the microelement metabolism in the pathological course of pregnancy and the newborn period. When studying the content of heavy metal salts in the blood serum of pregnant women exposed to metal pollutants, an imbalance of all studied trace elements, especially lead, was detected, the content of which exceeded 2–2.5 times the level of control data ( $p < 0.001$ ). The same pattern was found in the study of the content of trace elements in the placenta in pregnant women living in the zone of excessive exposure to heavy metal salts, which indicates the ability of the placental tissue to concentrate and accumulate toxic microelements. The revealed changes play an important role in the development of dysfunction and depletion of the placenta in women of the main group (Table).

The transplacental transition of heavy metals and its reason for the onset of pathology in pregnant women and newborns was confirmed by identified significant increase in lead in mother's hair (4 times) with a severe degree of pre-eclampsia and their preterm infants (3 times).

TABLE I. MORPHOLOGICAL ASSESSMENT OF PLACENTAL INSUFFICIENCY

Morphological assessment of placental insufficiency	Control group (n = 50)	Main group (n = 70)
Compensated	82 %	62.2 %
Subcompensated	18 %	28 %
Decompensated	–	9.8 %

## V. CONCLUSION

Thus, as a result of the conducted research, the important role of the influence of heavy metals (lead, cadmium) on the incidence of adverse pregnancy outcomes in the residents of Vladikavkaz was proved once again. In addition, the combined treatment of pregnant women living in areas of ecological distress has led to an improvement in the parameters of the placental complex and the fetal intrauterine condition. The regularity of the revealed complications confirms the assumption that the complex influence of adverse environmental factors (duration of exposure, timeliness of adequate therapeutic measures taken) depends on the adaptive capabilities of the pregnant woman's body, and, consequently, the outcome of pregnancy for both the mother and the fetus.

## References

- [1] A.N. Stozharov, *Medical Ecology*. Minsk, 2007, 343 p.
- [2] O.V. Sivochalova, "Problems of management of reproductive risks", *Hygiene and sanitation*, no. 6, pp. 45–48, 2012.
- [3] P.N. Baskakov, S.E. Regushevsky, "Prevention of perinatal pathology in women with a pathological preliminary period against the background of fetoplacental insufficiency", *The reproductive health of a woman*, pp. 45–49, 2015.
- [4] V.F. Demin, *Ecopathology in infancy Pediatrics*, pp. 15–41, 2011.
- [5] Yu.V. Orlov, "Features of the course of pregnancy and childbirth under conditions of anthropogenic environmental pollution", *Materials of the VI Russian Forum "Mother and Child"*, pp. 150–151, 2004.
- [6] V.I. Grischenko, N.A. Shcherbina, "Improving the diagnosis and therapy of perinatal pathology", *Obstetrics and gynecology*, no. 10, pp. 3–6, 2009.
- [7] L.I. Kalakutsky, "New technology for diagnosing the state of the fetus in childbirth", *Tyumen med. J.* no. 2, pp. 3–7, 2015.
- [8] V.I. Kulakov, G.T. Sukhikh, N.E. Kann et al., "Cytokine content in amniotic fluid, cord blood and blood serum of women with intrauterine infection", *Obstetrics and gynecology*, no. 5, pp. 14–17, 2012.
- [9] J. Ransom, M. Fischer, T. Mosman, F. Vorota, "Interferon – is produced by activated immature mouse thymocytes", *Immunol*, no. 12, pp. 4102–4108, 2016.
- [10] V.N. Serov, V.L. Tyutyunnik, V.V. Zubkov et al., "Perinatal outcomes in pregnant women with infectious diseases and placental insufficiency", *Obstetrics and gynecology*, no. 3, pp. 16–21, 2013.
- [11] M. Metzenbauer, E. Hafner, D. Hoefinger et al., "Three-dimensional ultrasound measurement of the placental volume in early pregnancy: method and correlation with biochemical placenta parameters", *Placenta*, vol. 22, no. 6, pp. 602–605, 2011.
- [12] S. Yoshioka, H. Fujiwara, T. Nakayama, "Intrauterine administration of autologous peripheral blood mononuclear cells promotes implantation rates in patients with repeated failure of IVF-embryo transfer", *Hum. Reprod.*, vol. 21, no. 12, pp. 3290–3294, 2009.