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SOME FEATURES OF CELLULAR ENERGY SUPPLY OF THE BODY IN PREMATURE INFANTS WITH SEVERE FORMS OF PERINATAL PATHOLOGY

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Summary

The nature of postnatal adaptation of newborns, their further growth, development, health status and quality of life largely depend on the well-being of intrauterine development and maturity at birth. Premature birth under hypoxia causes significant metabolic disorders in the body, is accompanied by a high risk of severe organ dysfunction, which requires in-depth research to clarify the features of intracellular metabolism in order to further improve methods of diagnosis and treatment of newborns with various forms of perinatal pathology.

Aim of the research. *To study the trends of changes in energy metabolism in premature infants with severe forms of perinatal pathology to investigate the possibility of using them as additional criteria of hypoxic damage to the body in conditions of morphological and functional immaturity.*

Materials and methods. *Clinical and laboratory examinations were performed on 68 newborns with severe forms of perinatal pathology at the gestational age of 32 to 34 weeks; the comparison group consisted of 27 conditionally healthy newborns at the gestational age of 34 to 37 weeks. Inclusion criteria for the main study group: gestational age at birth from 32 to 34 weeks, clinical signs of severe perinatal pathology. Exclusion criteria: gestational age at birth < 32 and ≥ 37 weeks, diagnosed congenital malformations and septic conditions. The list of diseases was determined according to the International Classification of Diseases, X Revision. The following blood serum laboratory parameters were studied: lactate level, glycerol-3-phosphate dehydrogenase (GPDH) (EC 1.1.99.5), succinate dehydrogenase (SDH), NADH dehydrogenase (NADH) (EC 1.6.5.3); the electron transport chain coefficient (ETC) was calculated. Laboratory studies were performed using micromethods.*

The study was conducted in accordance with the provisions of GCP (1996), the Convention of the Council of Europe on Human Rights and Biomedicine (April 4, 1997), the Declaration of Helsinki of the World Medical Association (1964-2008), Order of the Ministry of Health of Ukraine No. 690 dated September 23, 2009 (as amended by Order of the Ministry of Health of Ukraine No. 523 dated July 12, 2012). Protocol of scientific research of the Biomedical Ethics Committee of BSMU dated September 12, 2015. Informed written consent was obtained from the parents of the patients before the study with an explanation of the purpose, objectives and methods of laboratory testing.

Statistical processing of the results was performed using STATISTICA software (StatSoft Inc., USA, version 10). Comparison of quantitative indicators with normal distribution was performed using Student's t-test, and the probability of differences was considered statistically significant at $p<0.05$.

The complex of studies was conducted within the framework of the planned research topics of the Department of Pediatrics, Neonatology and Perinatal Medicine of the Bukovinian State Medical University: «Improvement of the areas of prognosis, diagnostics and treatment of perinatal pathology in newborns and infants, optimization of the schemes of catamenial observation and rehabilitation» (State registration No. 0115U002768, term of execution 01.2015-12.2019) and «Chronobiological and adaptive aspects and features of vegetative regulation in pathological conditions in children of different age groups» (State registration No. 0122U002245, term of execution 01.2020-12.2024).

Results. *In newborns of the main group, in comparison with the control group, a significant decrease in GFDH and SDH was found, which indicates a significant impairment of the activity of enzymes of the respiratory chain and explains the lack of oxygen absorption in the body at the cellular and tissue level, causing the severity of the condition of newborns. Determination of the level of GPDH and SDH in the dynamics of observation in children showed some improvement in these indicators. In the severe condition of newborns, a significant increase in the NADPH index was found, with a further probable increase in its level in the dynamics of observation. Calculations of ETC coefficient in cord blood showed a significant decrease of this indicator in comparison with the control group. The identified disorders of intracellular energy metabolism under hypoxia indicate the expediency of conducting comprehensive scientific research to study the possibilities of appropriate pharmacological correction to improve the effectiveness of treatment of severe forms of perinatal pathology in premature infants.*

Conclusions: *1. The results of the study revealed a significant decrease in GPDH and SDH at elevated levels of NADPH and ETC coefficient, which confirms the presence of significant disturbances in intracellular energy metabolism and mitochondrial oxidation processes. 2. Timely detection of metabolic disorders with the determination of mitochondrial oxidation, in particular energy metabolism, is an important area for improving diagnostic measures in severe forms of perinatal pathology in preterm infants with hypoxic damage to the body in the pathogenesis.*

Key words: *Neonates; Preterm Infants; Hypoxia; Mitochondrial Insufficiency; Energy Metabolism.*

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Introduction

According to the Center for Medical Statistics of the Ministry of Health of Ukraine, since 2013 fertility rates in Ukraine have been on a downward trend, with the largest decrease observed since 2022. In 2021, 273,772 children were born, in 2022-206,032, and in 2023-187,387, which is almost 32.0 % less than in 2021.

It should also be noted that there is a tendency for a significant incidence of preterm births with the birth of children of gestational age from 22 to 37 weeks. In general, the number of preterm births in the world is about 10 %, which is considered one of the major causes of neonatal morbidity and mortality [1]. In the post-war period, fertility rates are not expected to increase, mainly due to the objective deterioration of economic conditions and social instability in the country, so it is very important to preserve the life and health of each child.

The nature of postnatal adaptation of newborns, their further growth, development, health and quality of life largely depend on the well-being of intrauterine development and maturity at birth. Premature birth under hypoxia causes significant metabolic disorders in the body, is accompanied by a high risk of severe organ dysfunction, which requires in-depth research to clarify the features of intracellular metabolism in order to further improve methods of diagnosis and treatment of newborns with various forms of perinatal pathology.

The adverse effects of hypoxia are considered to be a universal factor of damage to the body of children when adverse factors are realized during the prenatal, intrauterine and postnatal period. The consequence of hypoxia is the formation of hypoxic-ischemic injury (HII) of the body with the development of neonatal encephalopathy (NE). According to the literature, the incidence of NE reaches 10-20 per 1000 live births in low- and middle-income countries. Despite the results of the implementation of modern recommendations based on the results of scientific research in recent years, severe NE remains one of the leading causes of mortality in the early neonatal period, as well as severe neuropsychiatric consequences with the formation of childhood disability in later years of life [1,2]. This is especially true for the category of preterm infants, due to the peculiarities of the body's adaptation in conditions of morphological and functional immaturity and the negative impact of perinatal risk factors.

The molecular and clinical mechanisms of the formation of HII in newborns have been actively discussed in recent years [3, 4]. Against the background of circulatory insufficiency, various kinds of dysmetabolic changes occur in the child's body, in particular, intracellular energy metabolism disorders, which causes mitochondrial dysfunction. Uncontrolled activation of free radical oxidation (FRO) with insufficient antioxidant defense mechanisms (ADM) causes the development of glutaminergic excitotoxicity, apoptosis and cell necrosis [2, 5].

In order to substantiate recommendations for improving the effectiveness of therapeutic measures in severe forms of perinatal pathology in premature infants, it is advisable to conduct comprehensive studies that include the study of the peculiarities of intracellular energy metabolism in the body under conditions of hypoxia. The results obtained will allow us to improve the approaches to laboratory diagnostics in the early neonatal period, which will help reduce perinatal, neonatal and infant mortality, prevent the development of functional and chronic diseases, and preserve the quality of life of patients.

Aim of the research. To study the trends of changes in energy metabolism in premature infants with severe forms of perinatal pathology, to examine the possibility of using them as additional criteria of hypoxic damage to the body in conditions of morphological and functional immaturity.

Materials and methods

A clinical and laboratory study was performed on 68 newborns with a gestational age of 32 to 34 weeks who showed clinical signs of severe disease in the early neonatal period. The comparison group consisted of 27 conditionally healthy infants with a gestational age of 34 to 37 weeks.

Inclusion criteria for the main study group: gestational age at birth from 32 to 34 weeks, clinical signs of severe perinatal pathology. Exclusion criteria: gestational age at birth < 32 and ≥ 37 weeks, diagnosed congenital malformations and septic conditions. The list of diseases was determined according to the International Classification of Diseases, X Revision.

The state of intracellular energy metabolism was assessed by laboratory determination of the following parameters in blood lymphocytes: glycerol-3-phosphate dehydrogenase (GPDH) (EC 1.1.99.5), succinate dehydrogenase (SDH) (EC 1.3.99.1) and NADH dehydrogenase (NADH) (EC 1.6.5.3); lactate was determined in blood serum. Using the values of SDH, GPDH and NADPH, the electron transport chain coefficient (ETC) was calculated = SDH-GPDH+NADPH. Laboratory studies were performed using micromethods. Umbilical cord blood was collected in an amount of 1.0 ml, to which was added 0.1 ml (500 U) of heparin diluted with 0.4 ml of 0.9 % NaCl in a ratio of 1:4. Plasma was separated by centrifugation of heparinized blood at 3 thousand rpm and frozen in tubes at –120C.

The study was conducted in accordance with the provisions of GCP (1996), the Convention of the Council of Europe on Human Rights and Biomedicine (April 4, 1997), the Declaration of Helsinki of the World Medical Association (1964-2008), Order of the Ministry of Health of Ukraine No. 690 dated September 23, 2009 (as amended by the Order of the Ministry of Health of Ukraine No. 523 dated July 12, 2012). Protocol of scientific research of the Biomedical Ethics Committee of BSMU dated September 12, 2015. Informed written consent was obtained from the parents of the patients before the study with an explanation of the purpose, objectives and methods of laboratory testing.

Statistical processing of the results was performed using STATISTICA software (StatSoft Inc., USA, version 10). Comparison of quantitative indicators with normal distribution was performed using Student's t-test, and the probability of differences was considered statistically significant at $p<0.05$.

The complex of studies was conducted within the framework of the planned research topics of the Department of Pediatrics, Neonatology and Perinatal Medicine of the Bukovinian State Medical University: «Improvement of the areas of prognosis, diagnostics and treatment of perinatal pathology in newborns and infants, optimization of the schemes of catamenial observation and rehabilitation»

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Study results and discussion

Current data from the scientific literature indicate significant health problems and a decrease in the quality of life in children who have suffered severe forms of hypoxic damage due to exposure to negative factors during the antenatal, perinatal and postnatal period. This is especially true for the category of premature infants who, in a significant percentage of cases, have a history of clinical manifestations of prolonged somatic dysfunction after birth and, accordingly, a high risk of functional and organic pathology with deviations in physical and neuropsychological development.

The transition from intrauterine to extrauterine life after umbilical cord clamping in a newborn is characterized by complex physiological changes in the body, accompanied by the activation of stress-limiting systems to ensure the establishment of independent breathing and the restructuring of blood circulation [6, 7]. Usually within a few minutes after birth, the partial pressure of oxygen (PaO_2) in children increases from 3.3 kPa (25-35 mm Hg) to 10.5 kPa (80-90 mm Hg), especially in 5 minutes in full-term infants and in 7-8 minutes in preterm infants. Oxygen deficiency in the body in the postnatal period is an important factor in intracellular metabolic disorders, causing tissue, organ and systemic dysfunction. The negative effect of hypoxia on the body is considered a general energy distress – a syndrome that requires in-depth scientific research to clarify the depth of disorders, taking into account the severity of the newborn condition [8, 9].

In modern scientific literature there are enough data on damage to the nervous system, disorders of physical, neuropsychological development and the incidence of somatic pathology in children due to hypoxia in the implementation of adverse factors in the prenatal, perinatal and postnatal period [10]. There is a high probability of a decrease in the quality of life of patients due to the development of residual neurogenic, mental and musculoskeletal dysfunction, despite intensive care in the acute period of early neonatal diseases – the period that is considered the most critical for the formation of the main adaptive mechanisms of the postnatal body.

In the course of the research we analyzed the clinical and paraclinical features of adaptation of 68 premature infants with gestational age of 32 to 34 weeks who had clinical manifestations of severe perinatal pathology, in particular, we studied the trends of changes in some indicators of intracellular energy metabolism, compared with the results of examination of 27 conditionally healthy newborns with gestational age of 34 to 37 weeks.

Anthropometric parameters of children in the main group at birth: body weight 1547.83±141.48 g, body length 35.96±1.24 cm, head circumference 30.43±1.92 cm, trunk circumference 27.90±2.07 cm. Anthropometric parameters of newborns in the comparison group were as follows: body weight 2243.0±39.55 cm, length 43.9±0.07 cm, head circumference 30.6±0.25 cm, and trunk circumference 29.9±0.22 cm.

The severity of illness in the newborns of the main study group was due to respiratory distress syndrome (RDS) and central nervous system (CNS)/HII in all 68 cases (100.0 %); 17 children (25.0 %) were diagnosed with acute asphyxia; 18 children (26.47 %) had confirmed antenatal fetal damage. Clinically, 28 cases (41.18 %) of the main group of children had excitement syndrome, 40 cases (58.82 %) had depression syndrome; 3 children (4.41 %) were diagnosed with hydrocephalus syndrome. Some newborns had signs of hemorrhagic CNS lesions, in particular, 35 children (51.47 %) had subependymal hemorrhage of first and second degree according to neurosonography, and 12 children (17.67 %) had intraventricular hemorrhage. In addition, the severity of the condition of children in this group was due to the syndrome of vegetative-visceral dysfunction, which was accompanied by significant dysmetabolic changes against the background of morphological and functional immaturity of the body. 23 newborns (33.82 %) were diagnosed with multiple organ failure syndrome, and 12 children (17.65 %) had cerebral edema. Of the total number of newborns in this group, 37 children (54.41 %) required prolonged artificial lung ventilation due to severe respiratory failure. In 36 children (52.94 %) there was a risk of intrauterine infection, taking into account the mother's history of pregnancy and childbirth.

The newborns in the comparison group had a satisfactory course of early neonatal adaptation, despite the presence of a number of prenatal risk factors. The children were in the same room as their mothers and were exclusively breastfed.

In the course of the research we studied the indicators of energy metabolism in newborns with severe forms of perinatal pathology in comparison with the indicators in the group of children who had a satisfactory course of early neonatal adaptation. The evaluation of indicators was also carried out in the dynamics of observation of newborns during the first two weeks of life. The results are shown in the Table.

The results of the study showed a slightly higher level of lactate in umbilical cord blood in children of the main group compared to the control group, but no significant difference was noted. Lactate levels in the dynamics of newborn observation showed a significant decrease in lactate levels, which was accompanied by clinical signs of stabilization of the newborn condition. The importance of determining this indicator in the blood serum of children at birth has been confirmed by a number of studies and practical experience. According to SHAH, Prakesh S., et al. 2022 [11], umbilical cord artery pH ≤7.1 mmol/L, which correlates with lactate levels, and excess buffer bases (BE) ≤-12 mmol/L are associated with more than 2.5 times the probability of neonatal death, and lactate levels in umbilical cord arterial or venous blood <3 mmol/L are associated with less than 2.5 times the probability of death. A cord arterial lactate level <3 mmol/L is also associated with a low likelihood of severe neurologic pathology in preterm infants. According to the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, an umbilical cord blood pH < 7.0 and/or an actual buffer base excess (BE) < –12 mmol/L are generally accepted thresholds for determining pathologic acidosis and are considered predictors of increased risk of seizure syndrome, HII, and cerebral palsy in infancy [12].

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Table

Indicators of energy metabolism in the preterm infants of the comparison groups

Indicators	Control Group	Main Group	
		1st day	12-14th day
	M±m	M±m	M±m
Lactate (mmol/L)	7,22±0,45	7,31±0,75	5,46±0,46*#
GPDH (μm²)	4,58±0,31	1,69±0,16*	3,62±0,28*#
SDH (μm²)	11,10±0,02	6,59±0,63*	8,42±0,80*#
NADPH (μm²)	5,78±0,55	9,36±0,85*	15,92±1,31*#
Coefficient ETC (U)	22,70±1,77	11,79±1,02*	22,13±1,88#

*Note: * – significant difference in indicators in comparison with the control group, p<0.05;*
 # – significant difference in indicators in children of the main group in the dynamics of observation, p<0.05.

The results of the study showed that in the newborns of the main group, in comparison with the control group, there was a significant decrease in the level of GPDH – 1.69±0.16 and 4.58±0.31 μm² (p<0.05) and the index of SDH – 6.59±0.63 and 11.10±0.02 μm² (p<0.05). The obtained data indicate significant disturbances in the activity of enzymes of the mitochondrial respiratory chain, resulting in insufficient oxygen uptake at the cellular level, which aggravates the severity of the condition of premature infants. Taking into account the importance of this link in the pathological process in the absence of pharmacological correction aimed at normalization of intracellular metabolism, the lack of effectiveness of traditional methods of treatment can be explained to some extent. Determination of the level of GPDH and SDH in the dynamics of observation in children showed some improvement in the indicators – respectively, 3.62±0.28 μm² and 8.42±0.80 μm², but they remained significantly lower compared to the indicators characteristic of the stable state of newborns, even if determined at birth.

In the severe condition of premature infants, a significant increase in NADPH levels was found in comparison with the control values – 9.36±0.85 and 5.78±0.55 μm² (p<0.05), with a significant increase in its level in the dynamics of observation – up to 15.92±1.31 μm². Recent studies on the activity of NADPH have revealed two independent and experimentally distinct activities of this enzyme. On the one hand, this protein contributes to the functioning of mitochondrial respiration by directing electrons to the respiratory chain; on the other hand, increased activation of NADPH can lead to the activation of proapoptotic mechanisms in mitochondria, causing cell death by apoptosis. It is assumed that in this case we can talk about a certain mechanism of redox processes, which is probably capable of switching conditions to a binary decision regarding life and death of cells with impaired metabolism [13].

Calculations of the ETC coefficient in cord blood in the severe condition of newborns showed a significant decrease of this indicator in comparison with the control group – 11.79±1.02 and 22.70±1.77 units, respectively (p<0.05). According to the literature, disruption of phosphorylation processes under stressful conditions, such as ischemia and reperfusion, leads to inhibition of cellular respiration, changing the intermediate potentials of the mitochondrial membrane. This leads to excessive ROS generation and cell apoptosis [14, 15, 16]. Determination of ETC coefficient in children of the main group in the dynamics of observation against the background of intensive care showed stabilization of this indicator – 22.13±1.88 units, which correlated with stabilization of general condition of newborns.

The study of mitochondrial oxidation processes and their disorders is important for understanding the development of pathological processes under hypoxia in the body. Mitochondria are intracellular organelles whose main function is to supply cells with energy in the form of ATP produced by the respiratory chain located on the inner mitochondrial membrane. The main steps of cellular respiration are glycolysis, pyruvate oxidation, the Krebs cycle and oxidative phosphorylation. The most important factor that negatively affects the functioning of mitochondria in the body is oxidative stress, a condition caused by the increased activity of free radical oxidation (FRO) in the absence of the mechanisms of the body's antioxidant defense system. [5, 6, 17, 18].

Primary energy deprivation leads to a significant decrease in ATP and an increase in lactate production. The inactivation of ATP-dependent pumps leads to an excessive influx of sodium ions into the cytoplasm, causing cellular edema. The simultaneous increase in intracellular calcium also has significant negative consequences, exacerbating edema, ischemia, microvascular damage, and necrosis. The secondary energy deficit phase begins 6-48 hours after the initial injury. The mechanisms of secondary energy deficit include increased oxidative stress, exatoxicity, inflammation, and mitochondrial dysfunction. Increased levels of FR lead to cell membrane damage, apoptosis, or cell necrosis [19, 20, 21].

According to the literature, disorders of energy metabolism in mitochondria cause activation of ROS processes. The phenomenon of ischemia-reperfusion that occurs during perinatal asphyxia causes an increase in the production of reactive oxygen species (ROS), activation of lipid peroxidation (LPO), oxidative modification of proteins (OMP), and, accordingly, stimulation of mechanisms that initiate cell apoptosis or necrosis. OS is thought to be particularly harmful to the neonatal brain [22, 23]. The results obtained during reoxygenation with high concentrations of oxygen also revealed the presence of mitochondrial dysfunction, which was accompanied by an increase in ROS. The results of scientific studies show

that premature infants, in contrast to full-term infants, have insufficient cellular energy supply and reduced activity of the antioxidant defense system, which, with increased levels of ROS products, provokes the development of cytolytic syndrome. [24, 25].

In our opinion, it is advisable to conduct comprehensive scientific studies of intracellular metabolism in premature infants in order to improve diagnostic methods and to study the possibilities of pharmacological correction of metabolic disorders in the acute period of neonatal diseases with hypoxic damage of the body in the pathogenesis.

Conclusions

1. The results of the study revealed a significant decrease in GPDH and SDH at elevated levels of NADPH and ETC coefficient, which confirms the presence of significant disturbances in intracellular energy metabolism and mitochondrial oxidation processes.

2. Timely detection of metabolic disorders with determination of mitochondrial oxidation, in particular energy metabolism, is an important area for improving diagnostic measures in severe forms of perinatal pathology, in the pathogenesis of which hypoxic damage to the body, in premature infants.

Prospects for further research: A comprehensive study of the characteristics of intracellular energy metabolism, free radical oxidation system, and antioxidant defense system to determine the functional significance of mitochondria in hypoxic damage in preterm infants.

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ДЕЯКІ ОСОБЛИВОСТІ КЛІТИННОГО ЕНЕРГЕТИЧНОГО ЗАБЕЗПЕЧЕННЯ ОРГАНІЗМУ У ПЕРЕДЧАСНО НАРОДЖЕНИХ ДІТЕЙ ПРИ ВАЖКИХ ФОРМАХ ПЕРИНАТАЛЬНОЇ ПАТОЛОГІЇ

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(м. Чернівці, Україна)

Резюме.

Характер постнатальної адаптації новонароджених, їх подальший ріст, розвиток, стан здоров'я і якість життя багато в чому залежать від благополуччя внутрішньоутробного розвитку та зрілості при народженні. Передчасне народження за умов гіпоксії є причиною суттєвих метаболічних порушень в організмі, супроводжується високим ризиком розвитку важкої органної дисфункції, що потребує проведення поглиблених досліджень для уточнення особливостей внутрішньоклітинного обміну речовин з метою подальшого удосконалення методів діагностики та лікування новонароджених з різними формами перинатальної патології.

Мета дослідження. Вивчити тенденції змін показників енергетичного обміну у передчасно народжених дітей при важких формах перинатальної патології для дослідження можливостей їх використання у якості додаткових критеріїв гіпоксичного ураження організму за умов морфо-функціональної незрілості.

Матеріали і методи дослідження. Проведено клініко-лабораторне обстеження 68 новонароджених гестаційним віком від 32 до 34 тижнів з важкими формами перинатальної патології; групу порівняння склали 27 умовно здорових новонароджених дітей гестаційним віком від 34 до 37 тижнів. Критерії включення до основної дослідної групи: термін гестації при народженні від 32 до 34 тижнів, клінічні ознаки перинатальної патології важкого ступеня. Критерії виключення: термін гестації при народженні < 32 та ≥ 37 тижнів, діагностовано вроджені вади розвитку та септичні стани. Перелік захворювань визначено згідно Міжнародній класифікації хвороб X перегляду. Досліджено наступні лабораторні показники сироватки крові: рівень лактату, гліцерол-3-фосфатдегідрогенази (ГФДГ) (КФ 1.1.99.5), сукцинатдегідрогенази (СДГ), НАДН-дегідрогенази (НАДНД) (КФ 1.6.5.3); розраховано коефіцієнт електронно-транспортного ланцюга (ЕТЛ). Лабораторні дослідження здійснювалися з використанням мікрометодик.

Наукові дослідження виконані з дотриманням положень GCP (1996 рік), Конвенції Ради Європи про права людини та біомедицину (від 4 квітня 1997 р.), Гельсінської декларації Всесвітньої медичної асоціації про етичні принципи проведення наукових досліджень за участю людини (1964-2008 рр.), наказу МОЗ України № 690 від 23.09.2009 р. (із змінами, внесеними згідно з Наказом Міністерства охорони здоров'я України № 523 від 12.07.2012 р.). Протокол наукового дослідження Комісії з питань біомедичної етики БДМУ від 12.09.2015 року. Інформована письмова згода від батьків пацієнтів була отримана перед початком дослідження з роз'ясненням мети, завдань та методів лабораторного дослідження.

Статистична обробка результатів здійснювалася з використанням програмного забезпечення «STATISTICA» (StatSoft Inc., USA, Version 10). Порівняння кількісних показників з нормальним розподілом проведено за допомогою t-критерію Стьюдента, вірогідність відмінностей вважали статистично значущою при $p<0,05$.

Комплекс досліджень проведено у межах виконання запланованих тем науково-дослідних робіт кафедри педіатрії, неонатології та перинатальної медицини Буковинського державного медичного університету: «Удосконалення напрямків прогнозування, діагностики і лікування перинатальної патології у новонароджених та дітей раннього віку, оптимізація схем катамнестичного спостереження та реабілітації» (Державний реєстраційний номер 0115U002768, термін виконання 01.2015 р. – 12.2019 р.) та «Хронобіологічні й адаптаційні аспекти та особливості вегетативної регуляції при патологічних станах у дітей різних вікових груп» (Державний реєстраційний номер 0122U002245, термін виконання 01.2020 р. – 12.2024 р.)

Результати. У новонароджених основної групи, порівняно з контролем, виявлено вірогідне зниження показників ГФДГ та СДГ, що свідчить про значні порушення активності ферментів дихального ланцюга та пояснює недостатність засвоєння кисню в організмі на клітинному та тканинному рівні, зумовлючи важкість стану новонароджених. Визначення рівня ГФДГ та СДГ в динаміці спостереження у дітей засвідчило деяке покращення даних показників. При важкому стані новонароджених виявлено значне підвищення показника НАДНД, при подальшому вірогідному зростанні його рівня у динаміці спостереження. Розрахунки коефіцієнту ЕТЛ у пуповинній крові показали суттєве зниження даного показниками порівняно з контрольною групою. Виявлені порушення внутрішньоклітинного енергетичного обміну за умов гіпоксії свідчать за доцільність проведення комплексних наукових досліджень з метою вивчення можливостей проведення відповідної фармакологічної корекції для підвищення ефективності лікування при важких формах перинатальної патології у передчасно народжених дітей.

Висновки: 1. Результатами досліджень виявлено суттєве зниження показників ГФДГ та СДГ при підвищеному рівні НАДНД та коефіцієнту ЕТЛ, що підтверджує наявність суттєвих порушень внутрішньоклітинного енергетичного обміну та процесів

мітохондріального окиснення. 2. Своєчасне виявлення метаболічних порушень з визначенням показників мітохондріального окиснення, зокрема енергетичного обміну, є актуальним напрямком удосконалення діагностичних заходів при важких формах перинатальної патології у передчасно народжених дітей, у патогенезі яких гіпоксичне ураження організму.

Ключові слова: новонароджені; передчасно народжені діти; гіпоксія; мітохондріальна недостатність; енергетичний обмін.

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