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COMPARATIVE ANALYSIS OF BIOCHEMICAL INDICATORS OF CORD BLOOD OF NEWBORN RISK GROUPS REGARDING THE MANIFESTATION OF HEMOLYTIC DISEASE DEPENDING ON THE GROUP AND RHESUS SIGNS INHERITED FROM THE MOTHER

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The paper analyzes the interrelationship of a group of biochemical indicators (total bilirubin and its fractions, total protein, albumin, urea, creatinine, uric acid, and glucose) of umbilical cord blood of newborns (103 samples) depending on the group or rhesus trait inherited from the mother. Babies belonged to the risk group for the development of hemolytic disease of newborns without signs of the disease.

The determination of the content of the indicators was carried out by standardized unified methods, statistical processing was carried out according to the Mann-Whitney test (for the coincidence of the Rhesus characteristics of maternal and cord blood) and the Kruskal-Wallis test for comparing the average values of three or more samples (for the coincidence of maternal and cord blood groups with each other when inheriting this characteristic). The ratio of groups and rhesus was evaluated according to Fisher's comparative F-test (F-distribution), correlation analysis of indicators was performed according to Pearson's chi-squared test.

It is statistically shown that umbilical cord blood with a negative Rh(D) factor is characterized by a significantly higher level of glucose ($p=0,046$). A significantly higher indicator of the albumin-globulin coefficient is noted ($p=0,032$) when the group characteristic of umbilical cord blood matches with maternal blood.

The content of uric acid in umbilical cord blood from mothers with a negative Rh(D) factor was characterized by a significantly higher value ($p=0,024$), and the concentration of total bilirubin in such samples, on the contrary, was probably lower (compared to the group of children born from mothers with positive Rh(D)-factor, $p=0,023$).

In addition, the level of uric acid in umbilical cord blood depends on the mother's blood group: its lowest level was noted in umbilical cord blood samples from mothers with 0(I) blood group ($p<0.001$).

Therefore, the concentration of indicators of uric acid, total bilirubin, and glucose depend on the inheritance of group or rhesus traits from mother to child.

Key words: umbilical cord blood, biochemical indicators, glucose, uric acid, total bilirubin, albumin-globulin ratio, blood group, Rh(D) factor.

Introduction. Children born to mothers with 0(I) blood group according to the ABO system and with a negative Rh(D) factor, regardless of blood group, have a probability of developing hemolytic disease of the newborn due to group or Rhesus incompatibility (Hodovanets et al., 2018; Krog et al., 2022). The most severe manifestation of the development of hemolytic disease of infants is incompatibility for the Rh(D) factor, but it occurs quite rarely and even in the absence of prophylaxis, hemorrhagic disease of newborns develops in 0,5 % of healthy infants. It is likely that even in the absence of manifestations of hemolytic disease, certain clinical and biochemical metabolic changes are formed in healthy infants of this group as an adaptation mechanism in case of incompatibility of the mother's organism and the fetus by group or Rh(D) trait (Gruccio 2014; Myle, Al-Khattabi, 2014).

Materials and methods. In the work, a study of 103 umbilical cord blood samples was carried out with the determination of their group (according to the ABO system) and Rh(D)-factor, the content of the main biochemical indicators characterizing the nitrogen balance in blood serum was also investigated (total protein, albumin, creatinine, urea, uric acid), total bilirubin and its fractions, blood glucose level. The concentration of indicators was determined by generally accepted unified methods: total protein by the biuret reaction, albumin with bromocresol green, urea by the enzymatic urease method with salicylate hypochlorite, glucose by the glucooxidase method, the content of bilirubin and its fractions by the Jendrashik-Grof method with a diazoreagent. The methods of determination listed above were carried out using diagnostic sets of reagents of the manufacturer «Reagent», Dnipro, Ukraine. The content of uric acid was determined by

the enzymatic colorimetric method with uricase and peroxidase, creatinine by the modified Jaffe method without deproteinization with the formation of 2,4,6,-trinitrocyclohexadiene using diagnostic kits from the manufacturer «Cormay», Lomianki, Poland.

Group comparisons were carried out using the Mann-Whitney test (for the coincidence of the Rhesus characteristics of maternal and cord blood) and the Kruskal–Wallis test for comparing the average values of three or more samples (for the

coincidence of maternal and cord blood groups when inheriting this characteristic). The ratio of groups and rhesus was evaluated according to Fisher's Fisher's comparative F-test (F-distribution), correlation analysis of indicators was performed according to Pearson's chi-squared test.

Results and their discussion. The distribution of umbilical cord blood groups in relation to the maternal trait is characterized by the dominant trait of inheritance of the maternal blood group (tabl. 1).

Table 1.

Distribution of groups and Rh(D) factor of maternal and umbilical cord blood (n=103)

Umbilical cord blood				
	0(I)	A(II)	B(III)	AB(IV)
Maternal blood				
0(I)	40	12	18	---
A(II)	5	14	1	---
B(III)	1	1	3	3
AB(IV)	---	---	4	1

*Note: * – distribution differences are reliable, p<0,001*

Inheritance of a positive Rh(D)-factor in umbilical cord blood from mothers with a similar trait (63 samples) was characterized by a dominant advantage of a positive Rh(D)-factor: in umbilical cord blood samples from an Rh(D)-positive mother, only 10 samples were Rh(D)-negative trait, and in mothers with a negative Rh(D) factor (40 samples) only one quarter inherited a negative Rh(D) factor (n=9). In general, the group and Rh(D)-factor coincide with the maternal traits in 36 samples of umbilical cord blood, these data have a probabilistic nature of distribution with the exception of the nature of inheritance of the blood group according to the maternal trait.

As for biochemical parameters, it was noted that samples of umbilical cord blood from mothers with a negative Rh(D) factor had a significantly lower level of total bilirubin $35,95 \pm 1,12$ against $40,12 \pm 1,21$ $\mu\text{mol/l}$ with a positive ($M \pm m$, $p=0,023$). On the other hand, the content of uric acid in umbilical cord blood serum, on the contrary, was higher in mothers with a negative Rh(D)-factor and was $301,25 \pm 12,43$ $\mu\text{mol/l}$ compared to the average value in mothers with a positive Rh(D)- factor characteristic ($M \pm m=225,84 \pm 13,48$, $p=0,001$). Also, the lowest level of uric acid in umbilical cord blood is reliably observed in children from mothers with 0(I) blood group ($p<0,001$).

A reliable correlation was noted between the albumin and total protein indicators ($r_{xy}=0,631$, $p=0,000$) for all umbilical cord blood samples. In addition, when the umbilical cord blood group

matches the mother's according to the Rh(D) factor (58 samples), a significantly higher average level of the albumin-globulin coefficient is shown: $3,31 \pm 0,2$ as opposed to $2,70 \pm 0,21$ ($M \pm m$, $p=0,032$) when the sign does not match.

The average indicator of glucose concentration in umbilical cord blood was significantly higher in mothers with a negative Rh(D) factor – $4,66 \pm 0,28$ mmol/l compared to $4,66 \pm 0,28$ mmol/l in mothers with a positive Rh (D)-factor ($p=0,046$).

Conclusions. Inheritance of most biochemical parameters as well as group and Rhesus characteristics from mother to child is mostly probable. But we noted a correlation of albumin and total protein indicators, regardless of the inherited trait of the blood group and the Rh(D) factor. The reliability of the change in the average values of glucose, total bilirubin, and uric acid depends on the maternal sign of Rh(D) factor of inheritance and the nature of its inheritance.

Conflict of interest. *The research was conducted in the absence of any commercial or financial relationship that could be interpreted as a potential conflict of interest.*

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ПОРІВНЯЛЬНИЙ АНАЛІЗ БІОХІМІЧНИХ ПОКАЗНИКІВ ПУПОВИННОЇ КРОВІ НОВОНАРОДЖЕНИХ ГРУПИ РИЗИКУ ЩОДО ПРОЯВУ ГЕМОЛІТИЧНОЇ ХВОРОБИ ЗАЛЕЖНО ВІД УСПАДКОВАНОЇ ВІД МАТЕРІ ГРУПОВОЇ ТА РЕЗУСНОЇ ОЗНАКИ

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У роботі проведений аналіз взаємозв'язку групи біохімічних показників (загального білірубіну та його фракцій, загального білка, альбуміну, сечовини, креатиніну, сечової кислоти та глюкози) пуповинної крові новонароджених (103 зразки) залежно від успадкованої від матері групової чи резусної ознаки. Немовлята відносилися до групи ризику розвитку гемолітичної хвороби новонароджених без ознак прояву захворювання.

Визначення вмісту показників проводили стандартизованими уніфікованими методиками, статистичну обробку здійснено за критерієм Манна-Уїтні (за співпаданням резусних ознак материнської крові з пуповинною) та за критерієм Краскелла-Уолісса для порівняння середніх значень трьох та більше вибірок (за співпадання материнської та пуповинної груп крові між собою при успадкуванні даної характеристики). Співвідношення груп та резусів оцінювали за порівняльним критерієм Фішера (F-розподіл), кореляційний аналіз показників проводили за критерієм Пірсона.

Статистично показано, що пуповинна кров з негативним Rh(D)-фактор характеризується достовірно вищим рівнем глюкози ($p=0,046$), при співпаданні групової ознаки пуповинної крові з материнською відмічено достовірно вищий показник альбуміно-глобулінового коефіцієнту ($p=0,032$).

Вміст сечової кислоти у пуповинній крові від матерів з негативним Rh(D)-фактор характеризувався достовірно вищою величиною ($p=0,024$), а концентрація загального білірубіну у таких зразках, навпаки, – вірогідно нижча (у порівнянні з групою, народжених від матерів з позитивним Rh(D)-фактор ($p=0,023$)).

Окрім того, рівень сечової кислоти у пуповинній крові залежить від материнської групи крові: найнижчий його рівень відмічений у зразках пуповинної крові від матерів з 0(I) групою ($p<0,001$)

Отже, концентрація показників сечової кислоти, загального білірубіну, глюкози залежать від успадкування групових чи резусних ознак від матері до дитини.

Ключові слова: пуповинна кров, біохімічні показники, глюкоза, сечова кислота, загальний білірубін, альбуміно-глобуліновий коефіцієнт, група крові, Rh(D)-фактор

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