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PERINATAL OUTCOMES AND THEIR ASSOCIATION WITH VITAMIN D LEVELS

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Resume. The level of vitamin D in the blood serum of a pregnant woman plays an important role in the physiological course of the gestation period and the birth of healthy offspring. Perinatal outcomes depending on the mother's vitamin D level have been studied incompletely and are of great practical and scientific interest. The **purpose** of the study. Determining the relationship between maternal vitamin D levels and neonatal outcomes. **Materials and methods**. The analysis of the course of pregnancy, childbirth and the assessment of the condition of newborns in 180 women with normal levels, insufficiency and deficiency of vitamin D in the blood serum and umbilical cord blood of newborns was carried out. **Results**. In children with vitamin D deficiency and deficiency in umbilical cord blood, asphyxia of varying severity was more common, and it was also determined that newborns with low serum cholecalciferol levels have a direct relationship between a low Apgar score and the severity of asphyxia.

Key words: newborns, vitamin D, Apgar score, pregnancy.

ПЕРИНАТАЛЬНЫЕ ИСХОДЫ И ИХ СВЯЗЬ С УРОВНЕМ ВИТАМИНА D

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Резюме. Важную роль в физиологичном течении периода гестации и рождении здорового потомства играет уровень витамина D в сыворотке крови беременной женщины. Перинатальные исходы в зависимости от уровня витамина Д у матери изучены неполностью и представляют большой как практический, так и научный интерес. **Цель исследования**. Определение связи между уровнем витамина D у матерей и исходов у новорожденных. **Материал и методы.** Проведен анализ течения беременности, родов и оценка состояния новорожденных у 180 женщин с нормальным уровнем, недостаточностью и дефицитом витамина D в сыворотке крови и пуповинной крови новорожденных. **Результаты.** У детей с недостаточностью и дефицитом витамина D в пуповинной крови чаще отмечалась асфиксия различной степени тяжести, а также определено, что новорожденные с низким уровнем холекальциферола в сыворотке крови имеют прямую связь между низкой оценкой по шкале Апгар и степенью тяжести асфиксии.

Ключевые слова: новорожденные, витамин D, шкала Апгар, беременность.

PERINATAL NATIJALAR VA ULARNING D VITAMINI DARAJALARI BILAN ALOQASI

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Xulosa. Homiladorlik davrining fiziologik jarayonida va sog'lom nasl tug'ilishida homilador ayolning qon zardobidagi D vitamini darajasi muhim rol o'ynaydi. Onaning D vitamini darajasiga qarab perinatal natijalar to'liq o'rganilmagan va amaliy va ilmiy jihatdan katta qiziqish uyg'otadi. **Tadqiqotning maqsadi.** Onalarda D vitamini darajasi va

yangi tug'ilgan chaqaloqlarda natijalar o'rtasidagi bog'liqlikni aniqlash. **Materiallar va usullar.** Qon zardobida va yangi tug'ilgan chaqaloqning kindik qonida D vitamini etishmovchiligi va etishmovchiligi bo'lgan 180 ayolda homiladorlik, tug'ish va yangi tug'ilgan chaqaloqlarning holatini baholash. **Natijalar.** Kindik qonida D vitamini etishmovchiligi va etishmovchiligi bo'lgan bolalarda turli darajadagi asfiksiya tez-tez uchraydi, shuningdek, qon zardobida xolekalsiferol darajasi past bo'lgan yangi tug'ilgan chaqaloqlarda Apgar darajasining pastligi va asfiksiyaning og'irligi o'rtasida to'g'ridan-to'g'ri bog'liqlik borligi aniqlandi.

Kalit so'zlar: yangi tug'ilgan chaqaloqlar, D vitamini, Apgar shkalasi, homiladorlik.

Introduction. Vitamin D is a fat-soluble vitamin, a prohormone that regulates the body's strength and is associated with natural and adaptive immunity[1]. Recent research has provided new insights into the physiological roles of vitamin D, especially regarding its metabolism in the mother-placenta-fetus system and the prenatal effects of its metabolites. The placenta functions as an endocrine organ, facilitating the interaction between the mother and fetus. It produces and secretes various hormones, working together with the fetus to form an integrated endocrine system [2]. According to epidemiological data, vitamin D deficiency is widespread, particularly in vulnerable groups such as pregnant women and infants [3]. The levels of 25-hydroxyvitamin D [25(OH)D] during pregnancy have been linked to maternal and fetal health outcomes. Studies show that the placenta actively absorbs $25(OH)D_3$ through endocytosis, converting it into 24,25-dihydroxyvitamin D3 and the active form, 1,25-dihydroxyvitamin D [$1,25(OH)_2D_3$]. These metabolites are then released into both the fetal and maternal circulations [4]. Recent research suggests that vitamin D may play a role in maintaining a healthy pregnancy by regulating inflammation and immunomodulation, affecting the maternal and fetal immune systems. Inflammation and immune dysregulation are associated with preterm birth, and low vitamin D levels may exacerbate these processes [5].

The crucial role of vitamin D and its metabolism in influencing maternal and fetal health outcomes is well-established. Adequate levels of 25(OH) vitamin D and its conversion into 1,25(OH)2 vitamin D are essential for both the mother and fetus, particularly in terms of skeletal growth and birth weight. This study highlights the pivotal function of the placenta, rather than maternal physiology alone, in facilitating the uptake of 25(OH) vitamin D and its conversion into the active $1,25(OH)_2$ vitamin D. This process plays a key role in regulating the availability of vitamin D metabolites to the fetus during pregnancy. The findings of this research significantly contribute to our broader understanding of the fundamental processes of fetal development. **The aim of the study.** Assessment of vitamin D levels in maternal and newborn blood serum and comparison with perinatal outcomes

Materials and methods. The assessment of the condition of 180 pregnant women, the course of the gestational period and the outcomes of childbirth, and the assessment of the condition of their newborns with a comparison of the level of vitamin D in the blood serum of the mother and child were carried out.

A general clinical, special obstetric examination was conducted. Biochemical examination - the level of 25-hydroxycholecalciferol (25-OH-D) was analyzed by chemiluminescent enzyme immunoassay (ELISA).

Pregnant women were divided into groups depending on the vitamin D content, according to the standards of the Russian Association Endocrinologists (2016) [6]: deficiency (less than 20 ng/ml); insufficiency (20-30 ng/ml) and optimal/normal (30 ng/ml or more).

Statistical analysis of the data was carried out in the form of absolute and relative (%) values using an application software package.

The average age of pregnant women was 26.1±2.3 years, ranging from 22 to 38 years.

Analysis of vitamin D levels in umbilical cord blood serum revealed that 90 (50%) newborns had vitamin D deficiency (group 1), 54 (30%) had insufficiency, and 36 (20%) cases had normal (sufficient) vitamin D levels (group 3). Consequently, every second child was born with a congenital vitamin D deficiency, which was 1.6 times more common than its deficiency, and 2.5 times more common than at normal levels.

A comparative average vitamin D level in the system showed that the difference in vitamin D concentration in the blood is not so great compared to all three groups. It should be noted that most of the women gave birth on time. However, preterm birth was more common in women with vitamin D deficiency compared to women with vitamin D deficiency (10% and 5.6%, respectively), while only preterm birth was observed (tabl. 1)

Table 1. Pregnancy outcomes in the 2nd and 3rd trimesters, (abs, %)

	1 group, (n=90)		**2 group, (n=54)**		**3 group, (n=36)**	
	Abs	%	abs	%	Abs	%
Premature birth	3	10	1	5.6	0	0*, **
Urgent birth	27	90	17	94.4	12	100
Note:	*P<0.05 – differences are significant in relation to group 1.					

	**P<0.05 – differences are significant in relation to group 2.

Analysis of anthropometric indicators of newborns showed that there were no significant differences in growth between groups (tabl. 2).

Table 2. Anthropometric indicators of newborns after birth, (M±m)

	Body weight, gr	Height, sm
1 group, (n=90)	2802, 7±353	49,1±1.4
2 group, (n=54)	2993,3±290	49,8±2,05
3 group, (n=36)	3240±319	50±1.25

Our findings align with the results of a meta-analysis conducted by J. Tyrrell et al. (2016), which also found no direct correlation between maternal 25(OH)D3 levels and neonatal birth weight [7]. However, our study revealed that when maternal serum cholecalciferol levels were within the optimal range, the average birth weight of the newborns was 1.08 and 1.15 times higher in comparison to groups 2 and 1 (2993.3 ± 290 and 2802.7 ± 353 grams, respectively). Thus, while maternal cholecalciferol concentrations do not appear to directly correlate with infant birth weight, optimal levels of vitamin D may still have a positive effect on fetal growth. The Apgar score showed that newborns with vitamin D deficiency had a low score at 1 and 5 minutes of life, compared with the groups with insufficient and normal vitamin D levels (tabl 3).

Table 3. Assessment of the condition of newborns according to the Apgar scale, (M±m)

	First minute	Fifth minute
1 group, (n=90)	5,3±2,82	6,3±2,82
2 group, (n=54)	5,8±1.13	6,7±1.21
3 group, (n=36)	7,1±0.88	8.8±0.93

At the same time, newborns with a mild degree of hypoxia (from 5 to 4 points) were observed in the 1st and 2nd groups. Whereas, the average Apgar score at 1 and 5 minutes was from 7 to 9 points in children with optimal vitamin D concentrations. It should be noted that with asphyxia of both mild and severe degrees of severity, children were born with insufficiency and deficiency of cholecalciferol, while in the control group there were not a single case of birth of children with severe asphyxia. Children with 8 points or higher on the Apgar scale were born 2 times more often in group 3 compared to groups 1 and 2 (33.3% each, respectively). A mild degree of asphyxia was observed in every 3rd newborn from groups 2 and 3 and in almost every 4th from group 1. Children with cholecalciferol deficiency in umbilical cord blood were 1.2 times more likely to be born with mild asphyxia compared to vitamin D deficiency. The analysis showed that severe asphyxia was 3 times more common in children of group 1 compared to group 2 (16.7% and 5.6%, respectively).

At the same time, the vitamin D levels in newborns with both deficiency and normal cholecalciferol levels were not significantly lower than those in the mothers. In cases of deficiency, the values were found to be identical (Table 4).

Table 4. Vitamin D content in mother and newborn in blood serum, (M, abs, ng/ml)

	Average maternal vitamin D level (n=180)	Average vitamin D level in a newborn, (n=180)
1 group	15,7±2,1	15,7±0,7
2 group	21,8±0,8	20,1±1,6
3 group	34,4±1,2	30,1±0,8

Conclusions. The levels of vitamin D in maternal and umbilical cord blood are almost the same. Every second pregnant woman and her newborn have a vitamin D deficiency. Pregnant women with vitamin D deficiency were almost twice as likely to have preterm births as women with vitamin D deficiency. The growth of the newborn does not depend on the concentration of cholecalciferol in the blood, but the weight of the newborn was unreliably higher in the group with a normal level of vitamin D. It should be noted that the assessment of newborns on the Apgar scale showed a direct relationship between low levels of cholecalciferol in the blood serum and the severity of asphyxia. The above data once again demonstrate the need to replenish vitamin D deficiency and insufficiency in pregnant women throughout pregnancy, which will subsequently likely be reflected in more favorable perinatal outcomes and vitamin D levels in both the mother and the newborn.

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