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## STRATEGIES FOR PROVIDING VITAMIN D BASED ON BLOOD BIOCHEMICAL INDICATORS IN RACHITIS

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### ANNOTATION

Modern pediatrics emphasizes that correction of phosphorus-calcium metabolism disorders in growing children suffering from rickets is impossible without a properly selected treatment strategy. As part of a study involving 203 children under one year of age, blood levels of 25(OH)D, calcium, and phosphorus were examined. The developed regimen, which provided for individual administration of vitamin D, calcium preparations, and general strengthening therapy, demonstrated high efficacy. This was reflected in a reduction in the clinical manifestations of rickets, its consequences, symptoms of spasmophilia, and an increase in the concentration of 25(OH)D<sub>3</sub> in blood serum.

**Key words:** rickets, treatment, blood serum 25(OH)D level, calcium and phosphorus levels, vitamin D.

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## СТРАТЕГИИ ОБЕСПЕЧЕНИЯ ВИТАМИНОМ D ОТ УРОВНЯ БИОХИМИЧЕСКИХ ПОКАЗАТЕЛЕЙ КРОВИ ПРИ РАХИТЕ

### АННОТАЦИЯ

Современная педиатрия подчеркивает, что коррекция нарушений фосфорно-кальциевого обмена у растущих детей, страдающих рахитом, невозможна без правильно подобранной тактики лечения. В рамках исследования, в котором приняли участие 203 ребенка до года, были изучены уровни 25(OH)D, кальция и фосфора в крови. Разработанная схема, предусматривающая индивидуальное назначение витамина D, препаратов кальция и общеукрепляющей терапии, продемонстрировала высокую эффективность. Это выразилось в снижении клинических проявлений рахита, его последствий, симптомов спазмофилии и увеличении концентрации 25(OH)D<sub>3</sub> в сыворотке крови.

**Ключевые слова:** рахит, лечение, уровень 25(OH)D в сыворотке крови, уровень кальция и фосфора, витамин D.

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## RAXITDA QONNING BIOKIMYOVIY KO'RSATKICHLARI DARAJASIDAN D VITAMINI BILAN TA'MINLASH STRATEGIYALARI

## ANNOTATSIYA

Zamonaviy pediatriya raxit bilan og'riqan o'sayotgan bolalarda fosfor-kalsiy almashinuvi buzilishlarini to'g'rilash to'g'ri tanlangan davolash taktikasisiz mumkin emasligini ta'kidlaydi. Bir yoshgacha bo'lgan 203 nafar bola ishtirok etgan tadqiqot doirasida qondagi 25 (OH) D, kalsiy va fosfor miqdori o'rganildi. D vitamini, kalsiy preparatlari va umumiy quvvatlantiruvchi terapiyani individual tayinlashni nazarda tutuvchi ishlab chiqilgan sxema yuqori samaradorlikni ko'rsatdi. Bu raxitning klinik ko'rinishlari, uning oqibatlari, spazmofiliya belgilarining kamayishi va qon zardobida 25 (OH) D3 konsentratsiyasining oshishi bilan ifodalandi.

**Kalit so'zlar:** raxit, davolash, qonzardobi 25(OH)D darajasi, kaltsiy va fosfordarajasi, D vitamini.

**Relevance:** The development of rickets in Uzbekistan is largely due to insufficient parental care for children, which is particularly noticeable in rural areas. Added to this are problems with mothers' health and specific aspects of newborn care. According to scientific data [5,9], it is common in the republic for rickets to be combined with increased excitability in children. This is caused by an imbalance in calcium and phosphorus metabolism. This problem is particularly dangerous for infants, as a deficiency of these vital substances can lead to spasmophilia, excessive excitability of the central and peripheral nervous systems, and decreased muscle tone, which significantly impairs the quality of life of infants [1,4,10].

It is important to understand that when determining the necessary dose of vitamin D for the prevention and treatment of rickets in developed countries, the main guideline is the level of 25(OH)D<sub>3</sub>. This metabolite, synthesized by the liver, is considered the main indicator. Many experts believe that the normative values of 25(OH)D<sub>3</sub>, and to a lesser extent 1,25(OH)<sub>2</sub>D<sub>3</sub> and 24,25(OH)<sub>2</sub>D<sub>3</sub>, may vary under the influence of factors such as race, age, season, and dietary characteristics. In addition, these values are also influenced by the specific methods used to measure them.

For decades, vitamin D supplements in the form of oil solutions or fish oil have been effective in preventing rickets. However, their form of release, as well as their unpleasant taste and smell, made them difficult to use in young children. Unfortunately, this often led to parents not following their doctors' recommendations.

Despite the existence of various, sometimes contradictory, opinions in pediatrics regarding the prevention of rickets and its methods, its importance cannot be denied. It is evident that the reduction in the incidence of rickets and new data on vitamin D are not always correctly perceived by some specialists who consider prevention unnecessary [5,6]. At the same time, adequate prevention and treatment of rickets are an integral part of maintaining normal phosphorus and calcium metabolism in a growing organism. These measures should be implemented provided that sufficient protein is consumed. Special attention should be paid to children who have had moderate to severe rickets: they should undergo dispensary observation for three years with quarterly medical examinations.

**Purpose of the work:** research into biochemical blood markers characteristic of rickets, with the aim of improving diagnosis and individual selection of vitamin D doses.

**Materials and methods:** The study involved 203 infants (under 1 year of age) whose health was assessed as satisfactory. To identify signs of rickets, a physical examination was conducted, including an assessment of indicators such as the rate of closure of the large fontanelle, the presence of rickety changes in the ribs ("rosary"), wrist width, muscle tone, degree of development (dystrophy), skin color, intensity of sweating, timing of teething, and psychomotor development. All participants underwent laboratory tests to determine the concentration of 25(OH)D, calcium, and phosphorus in their blood serum.

**Discussion of the results obtained:** Of the total number, 130 children were diagnosed with rickets, and 73 children were diagnosed with the consequences of perinatal damage to the nervous system. Mild rickets was observed in 84 (64.6±4.19%) children, with 53 (40.7±4.30%) experiencing an acute course and 31 (23.8±3.73%) experiencing a subacute course. The children often exhibited

fearfulness, restlessness, irritability, sleep disturbances, and decreased appetite. In addition, the children exhibited vasomotor skin excitability, manifested by red dermographism and sweating, especially on the scalp. Children with acute course had mild symptoms of osteomalacia, manifested by pliability of the skull bones and fontanelle edges.

Moderate rickets was diagnosed in 46 (35.3±4.19%) of the children examined, with 25 (19.2±3.45%) having acute rickets and 21 (16.1±3.22%) having subacute rickets. In addition to the above symptoms, the children also exhibited craniotabes, flattening of the occiput, head asymmetry, and brachycephaly. Some children with subacute rickets exhibited symptoms of osteoid hyperplasia, manifested as rachitic “beads,” pigeon chest, and muscle hypotonia.

Twenty-six (20%) children with rickets showed signs of spasmophilia due to acidosis combined with hypocalcemia. Of these, 19 (73%) children had low levels of 25(OH)D3 in their blood serum.

Determination of the level of 25(OH)D3 in the blood serum of children with rickets showed low levels in 112 (86.1%) of those examined and normal levels in 18 (13.8%). In children with CPDNS, low levels of 25(OH)D were found in 50 (68.4%), while 23 (31.5%) had normal levels.

The average values of 25(OH)D3 in the blood serum of children with mild rickets were 15.23±1.32 nmol/L, and in children with moderate rickets, 18.75±2.76 nmol/L. Calcium and phosphorus levels in mild rickets were 2.13±0.03 and 0.96±0.02 mmol/L, respectively, and in moderate rickets, 1.73±0.02 and 0.77±0.02 mmol/L, respectively. In children with rickets and CPDNS, the levels of 25(OH)D3, calcium, and phosphorus in blood serum were 17.4±4.24 nmol/L, 1.96±0.05, and 0.88±0.03 mmol/L, respectively. Normal levels of Ca and P in the blood (2.48±0.07 and 1.11±0.40 mmol/L, respectively) were determined in children, and they received only vitamin D without additional calcium supplements.

Based on the data obtained, the need to correct the treatment tactics for rickets becomes obvious. This requires mandatory analysis of laboratory indicators to prescribe a personalized therapeutic dose of vitamin D.

In children with mild rickets and reduced serum 25(OH)D3 levels (15.23±1.32 nmol/L), with normal calcium and phosphorus levels (2.48±0.07 and 1.11±0.40 mmol/L, respectively), vitamin D was prescribed at a dose of 2000 IU/day for 1-1.5 months until 25(OH)D normalized. The children were then transferred to a prophylactic dose of vitamin D – 4000 IU/week.

The therapeutic dose for observed children with reduced levels of 25(OH)D3 in blood serum (18.75±2.76 nmol/L), calcium and phosphorus (1.73±0.02 and 0.77±0.02 mmol/L, respectively) in moderate rickets was 4000 IU/day. The course of treatment lasted 30-45 days until 25(OH)D levels normalized, after which the children were also transferred to a prophylactic dose of vitamin D – 4000 IU/week. In cases of calcipenic forms, the children additionally received calcium supplements throughout the course of treatment.

With reduced levels of 25(OH)D (17.4±4.24 nmol/L), calcium, and phosphorus (1.96±0.05 and 0.88±0.03 mmol/L, respectively) in blood serum in combination with rickets with CPDNS, the dose of vitamin D was increased to 8000 IU/day for 1-1.5 months until the clinical manifestations (sweating, restlessness, sleep and appetite disorders) disappeared and biochemical parameters normalized.

The complex of therapeutic measures for rickets included general massage and therapeutic exercises.

Complex treatment of rickets produced a good therapeutic effect in all observed children. As a result of treatment, by days 10-12, the children's well-being improved, their appetite increased, the softness of the edges of the large fontanelle decreased, and the functions of the autonomic nervous system were restored. The restoration of muscle tone and motor functions proceeded more slowly, with positive dynamics observed only by the end of week 2.

During treatment, the levels of 25(OH)D3, calcium, and phosphorus in the blood serum of children with rickets increased by 6.46, 1.5, and 1.7 times, respectively. In mild rickets, the level of 25(OH)D was 105.49±8.98 nmol/L (P<0.001), in moderate rickets it was 124.39±14.36 nmol/L, and

the levels of calcium and phosphorus were  $2.97 \pm 0.02$  mmol/L ( $P < 0.05$ ) and  $1.52 \pm 0.17$  mmol/L ( $P < 0.01$ ), respectively.

In children treated with vitamin D in combination with CPDNS, the levels of 25(OH)D<sub>3</sub>, calcium, and phosphorus in blood serum also increased statistically significantly to  $131.54 \pm 21.14$  mmol/L,  $2.01 \pm 0.21$ , and  $1.83 \pm 0.13$  mmol/L, respectively. The results obtained indicate the high effectiveness of the proposed treatment regimen for rickets.

The study showed that the proposed protocol for treating rickets in children, which involves personalized administration of vitamin D in combination with calcium supplements and general strengthening measures, led to a statistically significant improvement in therapeutic outcomes. A regression of the clinical symptoms of rickets and its residual manifestations, as well as the relief of spasmophilia, was recorded. An increase in the concentration of 25(OH)D<sub>3</sub> in blood serum indicates the effectiveness of this approach, which justifies its widespread introduction into clinical practice in the republic.

**Conclusions:** Vitamin D deficiency plays a significant role in the pathogenesis of rickets. To more accurately determine the effect of calcium and phosphorus availability, a biochemical analysis was performed, which established a correlation between hypovitaminosis D and reduced levels of calcium (Ca) and phosphorus (P) in blood serum. It should be noted that the biologically active form of vitamin D is its hydroxylated derivative, which ensures adequate calcium absorption in the intestine.

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## АННАЛЫ КЛИНИЧЕСКИХ ДИСЦИПЛИН КЛИНИК ФАНЛАР ЙИЛНОМАСИ

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