Спеціалізований рецензований науково-практичний журнал для педіатрів та сімейних лікарів

Здоров'я дитини®

Том 17, № 8, 2022

ISSN 2224-0551 (print), ISSN 2307-1168 (online)

ПЕРЕДПЛАТНИЙ ІНДЕКС 95264

www.mif-ua.com

ZASLAVSKY Publishing house

Дніпровський державний медичний університет
Донецький національний медичний університет

Здоров'я дитини®

Здоров'я дитини
Child's Health

Спеціалізований рецензований науково-практичний журнал
Заснований в липні 2006 року
Періодичність виходу: 8 разів на рік

Том 17, № 8, 2022

Включений в наукометричні і спеціалізовані бази даних
Scopus,
НБУ ім. В.І. Вернадського, «Українiка наукова», «Наукова періодика України», JIC index, Ulrichsweb Global Serials Directory, CrossRef, WorldCat, Google Scholar, ICMJE, SHERPA/RoMEO, NLM-catalog, NLM-Locator Plus, OpenAIRE, BASE, ROAD, DOAJ, Index Copernicus, EBSCO, OUCI

mif-ua.com

ZASLAVSKY® Publishing house

Open Journal System

Зміст

Клінічна педіатрія

На допомогу педіатру

Неонатологія

Огляд літератури

Випадок із практики

Теоретична медицина

Contents

Clinical Pediatrics

To Help the Pediatrician

Neonatology

Review of Literature

Case Report

Theoretical Medicine

Здоров'я дитини

Клінічна педіатрія / Clinical Pediatrics

UDC 616.62-008.22-022.7-092-074-053.2:577.161.2 DOI: https://doi.org/10.22141/2224-0551.17.8.2022.1544

H.O. Lezhenko[1], O.Ye. Abaturov[2], N.A. Zakharchenko[1]
[1]Zaporizhzhia State Medical University, Zaporizhzhia, Ukraine
[2]Dnipro State Medical University, Dnipro, Ukraine

The pathogenetic role of vitamin D and vitamin D-binding protein in the development of urinary tract infection in children

Abstract. ***Background.*** *The aim of the research was to study the content of 1,25(OH)$_2$D$_3$ and vitamin D-binding protein (DBP) in the blood serum of children with urinary tract infections, taking into account the clinical form of the disease, and to determine their pathogenetic role in the development of urinary tract infections.* ***Materials and methods.*** *The study groups consisted of 84 children (mean age — 10.0 ± 1.3 years). The main group was divided into subgroups: the first one — 17 children with acute pyelonephritis, the second one — 21 patients with chronic pyelonephritis, the third one — 16 children with acute cystitis, the fourth one — 10 patients with unspecified urinary tract infections. The control group consisted of 20 relatively healthy children. The content of 1,25(OH)$_2$D$_3$ and DBP was investigated by immunoenzymatic analysis.* ***Results.*** *It was found that the development of the inflammatory process in the urinary tract was accompanied by a statistically significant ($p < 0.01$) decrease in the level of 1,25(OH)$_2$D$_3$ in the blood serum of the children of the main group compared to the controls. The level of 1,25(OH)$_2$D$_3$ in patients of all subgroups was significantly lower than that of the control group ($p < 0.01$), but there was no statistical difference between them. Serum level of DBP in the main group was statistically significantly ($p < 0.05$) increased compared to the controls, but we did not find a statistically significant difference between the subgroups studied.* ***Conclusions.*** *The development of an acute inflammatory process in the urinary tract in children occurs against the background of a statistically significant decrease in the blood level of 1,25(OH)$_2$D$_3$ combined with high levels of vitamin D-binding protein. This serves as a pathogenetic basis for the need to develop therapeutic and prophylactic schemes for prescribing vitamin D to children with urinary tract infections.*

Keywords: *children; urinary tract infection; vitamin D; vitamin D-binding protein*

Introduction

Despite significant advances in diagnosis and therapy, urinary tract infections (UTIs) are still widespread bacterial infections of childhood [1], second only to respiratory diseases in terms of prevalence. Delay in diagnosis and appropriate therapy can lead to serious complications such as renal scarring, hypertension and chronic kidney disease [2]. At present, the issues of the peculiarities of the immune system functioning in children, which allowed the inflammatory bacterial process to develop in the urinary system, and in some cases even created the conditions for the chronicity of the UTI process, remain uncertain. It is suggested that urinary tract protection may be highly dependent on specific soluble mediators derived from epithelial cells one of which is the bactericidal antimicrobial peptide cathelicidin, whose expression is stimulated by 1,25(OH)$_2$D$_3$ in epithelial cells, macrophages/monocytes, and neutrophils [3].

In recent years, several hundred reports on multicenter studies and meta-analyses dedicated to the study of the pathogenetic role of vitamin D in various pathological conditions have been conducted and published.

It is known that vitamin D is largely a regulator of innate immunity, although its classic functions are regulation of calcium-phosphorus homeostasis and control of bone

Для кореспонденції: Леженко Геннадій Олександрович, доктор медичних наук, професор, завідувач кафедри госпітальної педіатрії, Запорізький державний медичний університет, проспект Маяковського, 26, м. Запоріжжя, 69035, Україна; e-mail: genalezh@gmail.com
For correspondence: Hennadii Lezhenko, MD, Professor, Head of the Department of Hospital Pediatrics, Zaporizhzhia State Medical University, Mayakovsky avenue 26, Zaporizhzhia, 69035, Ukraine; e-mail: genalezh@gmail.com
Full list of authors information is available at the end of the article.

metabolism [4]. To date, many studies have focused on investigating the causes and consequences of reduced synthesis of $1,25(OH)_2D_3$ by the kidneys. It has been shown that the active form of vitamin D_3 stimulates autophagy, which has become a factor and mechanism critical for the control of intracellular pathogens, while $1,25(OH)_2D_3$-induced expression of the antimicrobial peptide LL37, which has pronounced antimicrobial properties, is a key component of anti-inflammatory responses [5]. Cathelicidin has the ability to suppress the inflammatory cascade that occurs after the attachment of the pathogen to the uroepithelium, thus alleviating the severity of UTI [6]. Various authors have shown that $1,25(OH)_2D_3$ inhibits the expression of Toll-like receptors on monocytes and the production of some inflammatory cytokines, such as interleukin (IL) 2, IL-6 and IL-17 [7]. Vitamin D deficiency can cause hypocalcemia, which, in turn, reduces the activity of neutrophils and lymphocytes [6]. All this suggests that the active form of vitamin D, $1,25(OH)_2D_3$, is able to control immune function at different levels.

Because vitamin D is highly lipophilic, there is an urgent need for serum protein carriers to ensure efficient delivery to target cells [8]. One of these is vitamin D-binding protein (DBP). DBP is mainly synthesized by liver parenchymal cells and expressed in several tissues, including liver, kidney, gonads, fat, and neutrophils. As a rule, it performs a transport function for various ligands and participates in the regulation of immune and inflammatory processes [9]. Due to the high ability to bind vitamin D and its metabolites, it regulates their bioavailability, increasing biological half-life and protecting them from hydroxylase-mediated catabolism [9]. Alshahawey M. (2021) notes that DBP is not affected by vitamin D levels, but is regulated by estrogen, glucocorticoids, and inflammatory cytokines [10]. Typically, only 1–2 % of the total circulating pool of DBP has bound vitamin D, and this percentage never rises above 5 % [11]. Against this background, the literature contains a certain number of works on the direct effect of DBP on the immune reactions [10, 12, 13].

So, this prompted us to study the role of vitamin D and DBP in children with UTI.

The purpose: to study the content of $1,25(OH)_2D_3$ and DBP in the blood serum of children with urinary tract infections, taking into account the clinical form of the disease, and to determine their pathogenetic role in the development of urinary tract infections.

Materials and methods

We examined 84 children aged 6 to 14 years (the mean age was 10.0 ± 1.3 years) who were hospitalized to the Zaporizhzhia Regional Children's Clinical Hospital in 2018–2020. The main study group included 64 children with primary urinary tract infections. Patients with urinary tract abnormalities, as well as those who received antibacterial therapy prior to the experiment, were excluded from the study. The children were divided into groups depending on the classification and taking into account the criteria for the diagnosis of UTI, according to the EAU guidelines, 2021 (levels of evidence I, II) [14], and the order of the Ministry of Health of Ukraine No. 627 dated 03.11.2008 [15].

The main group children were divided into four subgroups: the first included 17 children with acute pyelonephritis, the second — 21 patients with chronic pyelonephritis, the third — 16 children with acute cystitis, the fourth — 10 patients with unspecified urinary tract infections. The control group included 20 relatively healthy children, representative by sex and age, without any inflammatory signs of the urinary system.

The serum 1,25-dihydroxyvitamin D and DBP concentrations in patients included in the study were detected by enzyme-linked immunosorbent assay (ELISA) using a commercial kit by Immunodiagnostic Systems, $1,25(OH)_2D_3$ EIA (UK) and Human DBP ELISA Kit (Elabscience, USA), respectively.

The results obtained were processed by the method of variation statistics using statistical packages Excel and Statistica 13.0 (StatSoft Inc., No. JPZ8041382130ARCN10-J). The method of correlation analysis with the calculation of Spearman's rank correlation coefficient was applied. The non-parametric Mann-Whitney test (U) was used to assess differences between indicators. Differences were considered significant at $p < 0.05$.

All human studies complied with the ethical standards of the Institutional and National Research Committee and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. A complete set of data on children, their parents and physicians confirming the results of this study was not publicly available due to limited initial ethics approvals.

Results

The results of the research are presented in Fig. 1, 2.

As can be seen from the data shown in Fig. 1, the development of the inflammatory process in the urinary tract was accompanied by a predicted statistically significant

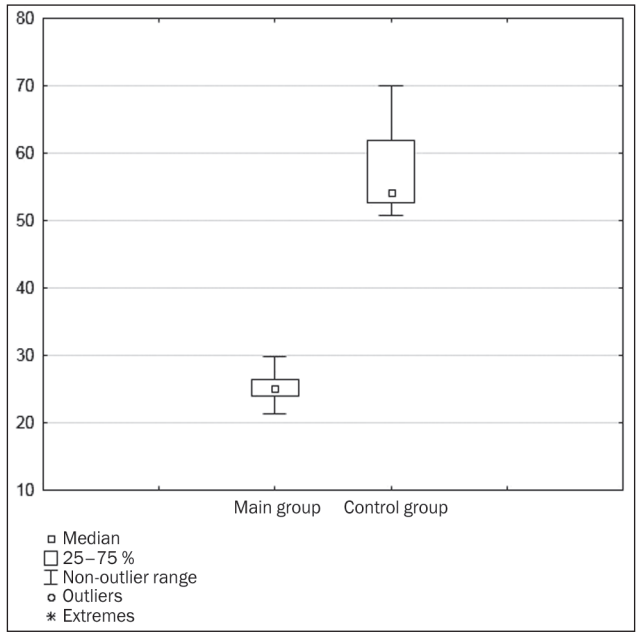

Figure 1. The content of $1,25(OH)_2D_3$ in the blood serum of children with urinary tract infection who were under observation

(25.1 (24.0; 27.4) pg/ml, $p < 0.01$) decrease in the level of $1,25(OH)_2D_3$ in the blood serum of children who were under our observation compared to the control group, where this indicator was 54.1 (52.6; 61.87) pg/ml.

In the process of further work with the actual material, we analyzed the content of $1,25(OH)_2D_3$ in the blood serum of children from the observation groups. The results of the comparisons are presented in Table 1.

As expected, the level of $1,25(OH)_2D_3$ in patients of all selected subgroups was significantly lower than that of the controls ($p < 0.01$), but without statistical difference between them. The obtained data indicate that vitamin D deficiency in children's blood serum may contribute to the development of UTI. The development of UTI might be a factor, which leads to increased utilization and subsequent deficiency of $1,25(OH)_2D_3$, considering that vitamin D plays a regulatory role in the development of the innate immune response. In particular, $1,25(OH)_2D_3$ promotes the synthesis of such antimicrobial peptides as cathelicidin and β-defensins under conditions of Toll-like receptors stimulation.

The next stage of our work was to study the level vitamin D-binding protein in the blood serum of children who were under our observation. This choice was due to the fact that DBP, in addition to its main function, i.e. the transport of vitamin D metabolites, performs a number of other functions, specifically influencing the functioning of the immune system due to the activation of macrophages, participation in chemotaxis, etc. [16].

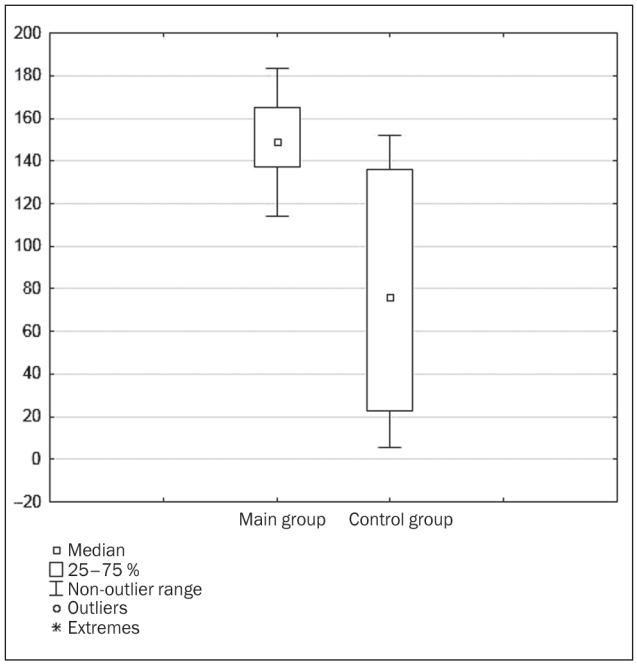

Figure 2. DBP content in the blood serum of children with urinary tract infection who were under observation

The obtained data showed a picture diametrically opposed to the one we observed during the analysis of the content of $1,25(OH)_2D_3$.

As can be seen in Fig. 2, the development of the inflammatory process in the urinary tract was accompanied by a statistically significant ($p < 0.05$) increase in the serum level of DBP in children of the main group compared to the controls: 148.3 (136.8; 164.9) vs. 75.9 (17.5; 135.6) ng/ml, respectively.

Later, according to the design of this study, we investigated the content of DBP in the blood serum of children of selected subgroups. The obtained results are presented in Table 1.

It was found that the development of the inflammatory process in the urinary tract in children of all subgroups was accompanied by an increase in the level of DBP in the blood serum, but we did not find a statistically significant difference between the subgroups studied.

Discussion

At present, there is no doubt about the role of vitamin D in the implementation and regulation of the effects of innate and acquired immunity [17]. It has been proven that the immunomodulatory effect of vitamin D is realized by expressing its receptors on immune cells [18]. Thus, $1,25(OH)_2D_3$ mediates the expression of antimicrobial peptides such as β-defensin and cathelicidin [19] an increased production of which, in turn, enhances the direct antibacterial effect on uropathogenic *E.coli* [20]. At the same time, the number of studies investigating the role of vitamin D in inflammatory diseases of the urinary system in children is quite limited. Li X. et al. (2021), Sadeghzadeh M. et al. (2021) demonstrated that the development of UTI occurred against the background of a low level of vitamin D in the blood serum. Hacıhamdioğlu D.Ö. et al. (2016) drew attention to the presence of vitamin D deficiency in the group of patients with UTI, they also noted that there was no significant difference between the serum vitamin D levels in patients with upper and lower UTI. The results of our work confirmed the stated data, namely, we noted a statistically significant ($p < 0.01$) decrease in the serum level of vitamin D in children with urinary tract infections compared to the control group, and did not find a significant difference between the levels of vitamin D in the studied subgroups.

On the other hand, in the modern literature there are some works in which the authors note an increased level of

Table 1. The content of $1,25(OH)_2D_3$ and DBP in the blood serum of children with urinary tract infection depending on the clinical form of the disease

Indicators	Control group (n = 20)	Subgroup 1 (n = 17)	Subgroup 2 (n = 21)	Subgroup 3 (n = 16)	Subgroup 4 (n = 10)
$1,25(OH)_2D_3$, pg/ml	54.1 (52.6; 61.87)	24.4 (24.1; 26.0)**	25.7 (24.0; 27.3)**	24.4 (22.9; 27.3)**	25.5 (24.8; 27.6)**
DBP, ng/ml	75.9 (17.5; 135.6)	161 (136.9; 171.4)**	146.4 (136.3; 163.1)*	147.3 (142.4; 157.7)*	143 (138.5; 163.2)*

Notes: * — $p < 0.05$ in comparison with the control group; ** — $p < 0.01$ in comparison with the control group.

vitamin D in patients with urinary tract infections. Thus, Mahyar A. et al. (2018) showed that the average level of 25(OH)D in the blood serum of children in the study group was significantly higher than in the control group. At the same time, there were no significant differences in the content of vitamin D in the blood serum of patients with acute pyelonephritis and cystitis. The authors recommend not prescribing additional vitamin D, as this may lead to an unregulated hyperactive immune response to infection, which, in turn, may be responsible for the increased risk of UTI [2].

At the same time, most authors point to vitamin D deficiency in inflammatory diseases of the urinary system [1, 20, 21]. Thus, Zasloff M. (2007) explained that with vitamin D deficiency, macrophages infected with bacterial agents cannot sufficiently induce expression of a number of antibacterial peptides. The lack of sufficient AMP synthesis creates conditions for the development and progression of UTI, and also deepens the severity of the disease [17, 22]. Thus, most authors point to the need for further development of both indications and schemes for the preventive and therapeutic use of vitamin D in UTI [6, 18, 20].

Vitamin D-binding protein has not become so widespread for research, although it was discovered in the 1960s. In the works of various authors, it is noted that deficiency or excess of vitamin D, resistance to vitamin D, idiopathic hypercalcemia in childhood, osteoporosis, and many other diseases do not affect the concentration of DBP in the blood serum [9, 23, 24]. These data appear logical, if we take into account the fact that only 5–10 % of the total amount of DBP is necessary for the transport of vitamin D metabolites to the point of realization of their biological effect [12]. DBP is a multifunctional protein. Its other functions include the ability to significantly enhance the chemotactic activity of chemoattractants of neutrophils; induce the selective recruitment of neutrophils; to absorb actin released from damaged or dead cells and to form DBP-actin complexes all of which underscore its important role during inflammation [11]. The given data explain the results we obtained, namely that the development of the inflammatory process in the urinary tract was accompanied by a statistically significant ($p < 0.05$) increase in the level of DBP in the blood serum of the children of the main group. During the literature data analysis, we noted that several authors have shown that the activation of neutrophils during inflammation increases their binding sites with DBP, which contributes to C5a-induced chemotaxis; however, binding of $1,25(OH)_2D_3$, but not $25(OH)D_3$ blocks DBP stimulation of C5a activity [23]. Additionally, Kew R.R. (2019) noted that $1,25(OH)_2D_3$ has a direct inhibitory effect on the function of the chemotactic cofactor DBP for neutrophils due to binding to DBP at physiological concentrations. Bikle D.D. and Schwartz J. (2019) pointed out that some cytokines, such as IL-6, increase the production of DBP. In turn, in our previous work [23], it was shown that the development of an acute inflammatory process in the urinary tract of children occurs precisely against the background of a significant increase in the expression of the pro-inflammatory cytokine IL-6 in the blood serum. Apparently, the revealed feature was one of the causes for the high levels of DBP in children with UTI.

Thus, pleiotropic active metabolites of vitamin D in combination with DBP influence the reaction of protective non-specific mechanisms with the determination of the nature of the inflammatory process and the ability to eradicate the infectious agent [17]. At the same time, the problem is still far from being solved and requires further research.

Conclusions

1. The development of an acute inflammatory process in the urinary tract in children occurs against the background of a statistically significant decrease in the level of $1,25(OH)_2D_3$ in the blood serum combined with high levels of vitamin D-binding protein.

2. The given data are the pathogenetic basis for the need to develop therapeutic and prophylactic schemes for the administration of vitamin D to prevent the occurrence and manage infectious diseases, including urinary tract infections in children.

References

1. Georgieva V., Kamolvit W., Herthelius M., Lüthje P., Brauner A., Chromek M. Association between vitamin D, antimicrobial peptides and urinary tract infection in infants and young children. Acta Paediatrica. 2018. 108(3). 551-6. doi: 10.1111/apa.14499.

2. Mahyar A., Ayazi P., Safari S., Dalirani R., Javadi A., Esmaeily S. Association between vitamin D and urinary tract infection in children. Korean Journal of Pediatrics. 2018. 61(3). 90. doi: 10.3345/kjp.2018.61.3.90.

3. Övünç Hacıhamdioğlu D., Altun D., Hacıhamdioğlu B., Çekmez F., Aydemir G., Kul M., Müftüoğlu T., Süleymanoğlu S., Karademir F. The association between serum 25-hydroxy vitamin D level and urine cathelicidin in children with a urinary tract infection. Journal of Clinical Research in Pediatric Endocrinology. 2016. 8(3). 325-9. doi: 10.4274/jcrpe.2563.

4. Sassi F., Tamone C., D'Amelio P. Vitamin D: nutrient, hormone, and immunomodulator. Nutrients. 2018. 10(11). 1656. doi: 10.3390/nu10111656.

5. Ismailova A., White J.H. Vitamin D, infections and immunity. Reviews in Endocrine and Metabolic Disorders. 2021. 23(2). 265-77. doi: 10.1007/s11154-021-09679-5.

6. Qadir S., Memon S., Chohan M.N., Memon Y. Frequency of vitamin-D deficiency in children with urinary tract infection: a descriptive cross-sectional study. Pakistan Journal of Medical Sciences. 2021. 37(4). doi: 10.12669/pjms.37.4.3896.

7. Charoenngam N., Holick M.F. Immunologic effects of vitamin D on human health and disease. Nutrients. 2020. 12(7). 2097. doi: 10.3390/nu12072097.

8. Chun R.F., Peercy B.E., Orwoll E.S., Nielson C.M., Adams J.S., Hewison M. Vitamin D and DBP: The Free Hormone Hypothesis revisited. Journal of Steroid Biochemistry and Molecular Biology. 2014. 144. 132-7.

9. Lisowska-Myjak B., Jóźwiak-Kisielewska A., Łukaszkiewicz J., Skarżyńska E. Vitamin D-binding protein as a biomarker to confirm specific clinical diagnoses. Expert Review of Molecular Diagnostics. 2019. 20(1). 49-56. doi: 10.1080/14737159.2020.1699064.

10. Alshahawey M. A genetic insight into vitamin D binding protein and COVID-19. Medical Hypotheses. 2021. 149. 110531. doi: 10.1016/j.mehy.2021.110531.

11. Kew R.R. The vitamin D binding protein and inflammatory injury: a mediator or sentinel of tissue damage? Frontiers in Endocrinology. 2019. 10. doi: 10.3389/fendo.2019.00470.

12. Chun R.F., Shieh A., Gottlieb C., Yacoubian V., Wang J., Hewison M., Adams J.S. Vitamin D binding protein and the biological activity of vitamin D. Frontiers in Endocrinology. 2019. 10. doi: 10.3389/fendo.2019.00718.

13. Xie Z., Wang X., Bikle D.D. Editorial: vitamin D binding protein, total and free vitamin D levels in different physiological and pathophysiological conditions. Frontiers in Endocrinology. 2020. 11. doi: 10.3389/fendo.2020.00040.

14. Hoen L., Bogaert G., Radmayr C., Dogan H., Nijman R., Quaedackers J., Rawashdeh Y., Silay M., Tekgul S., Bhat N., Stein R. Update of the EAU/ESPU guidelines on urinary tract infections in children. European Urology. 2021. 79. S446-S448.

15. Zakon.rada.gov.ua. Treatment protocol for children with urinary tract infections and tubolointerstitial nephritis. Available from: https://zakon.rada.gov.ua/rada/show/v0627282-08#Text (in Ukrainian).

16. Raymond M.-A., Désormeaux A., Labelle A., Soulez M., Soulez G., Langelier Y. et al. Endothelial stress induces the release of vitamin D-binding protein, a novel growth factor. Biochemical and Biophysical Research Communications. 2005. 338(3). 1374-82.

17. Abaturov A.E., Kryuchko T.A., Lezhenko G.A., Zavgorodnyaya N.Yu. Antimicrobial peptides and proteins of the respiratory tract, diagnostic significance and therapeutic possibilities. Kharkiv: Planeta-Print, 2018 (in Russian).

18. Sadeghzadeh M., Khoshnevisasl P., Motamed N., Faghfouri L. The serum vitamin D levels in children with urinary tract infection: a case-control study. New Microbes and New Infections. 2021. 43. 100911. doi: 10.1016/j.nmni.2021.100911.

19. Zendehdel A., Arefi M. Molecular evidence of role of vitamin D deficiency in various extraskeletal diseases. Journal of Cellular Biochemistry. 2019. 120(6). 8829-40. doi: 10.1002/jcb.28185.

20. Hertting O., Lüthje P., Sullivan D., Aspenström P., Brauner A. Vitamin D-deficient mice have more invasive urinary tract infection. PLOS One. 2017. 12(7). doi: 10.1371/journal.pone.0180810.

21. Li X., Yu Q., Qin F., Zhang B., Lu Y. Serum vitamin D level and the risk of urinary tract infection in children: a systematic review and meta-analysis. Frontiers in Public Health. 2021. 9. doi: 10.3389/fpubh.2021.637529.

22. Zasloff M. Antimicrobial peptides, innate immunity, and the normally sterile urinary tract. Journal of the American Society of Nephrology. 2007. 18(11). 2810-6. doi: 10.1681/ASN.2007050611.

23. Bikle D.D., Schwartz J. Vitamin D binding protein, total and free vitamin D levels in different physiological and pathophysiological conditions. Frontiers in Endocrinology. 2019. 10. doi: 10.3389/fendo.2019.00317.

24. Bouillon R., Schuit F., Antonio L., Rastinejad F. Vitamin D binding protein: a historic overview. Frontiers in Endocrinology. 2020. 10. doi: 10.3389/fendo.2019.00910.

25. Lezhenko H.O., Zakharchenko N.A. The pathogenetic role of some cytokines in the development and course of various clinical forms of urinary tract infections in children. Zdorov'e rebenka. 2022. 17(3). 128-32. doi: 10.22141/2224-0551.17.3.2022.1507.

Received 01.12.2022
Revised 15.12.2022
Accepted 20.12.2022

Information about authors
H. Lezhenko, MD, Professor, Head of the Department of Hospital Pediatrics, Zaporizhzhia State Medical University, Zaporizhzhia, Ukraine; e-mail: genalezh@gmail.com; https://orcid.org/0000-0003-0851-4586
O. Abaturov, MD, PhD, Professor, Head of the Department of Pediatrics 1 and Medical Genetics, Dnipro State Medical University, Dnipro, Ukraine; e-mail: alexabaturov@i.ua; https://orcid.org/0000-0001-6291-5386
N. Zakharchenko, MD, PhD Student of the Department of Hospital Pediatrics, Zaporizhzhia State Medical University, Zaporizhzhia, Ukraine; e-mail: natali_koms@ukr.net; https://orcid.org/0000-0002-3956-8571

Conflictso fi nterests. Authors declare the absence of any conflicts of interests and own financial interest that might be construed to influence the results or interpretation of the manuscript.
Information about funding. The work was performed within the research work of the department "Predicting the course of the most common inflammatory diseases of childhood". State registration number 0121U107520.
Authors' contribution: *Lezhenko H.O.* — research concept and design; critical revision of the article; final approval of the article, *Abaturov O.Ye.* — final approval of the article, *Zakharchenko N.A.* — collection and assembly of data; data analysis and interpretation; writing the article.

Леженко Г.О.[1], Абатуров О.Є.[2], Захарченко Н.А.[1]
[1]Запорізький державний медичний університет, м. Запоріжжя, Україна
[2]Дніпровський державний медичний університет, м. Дніпро, Україна

Патогенетична роль вітаміну D та вітамін D-зв'язуючого білка в розвитку інфекції сечовивідних шляхів у дітей

Резюме. Мета роботи. Дослідити вміст $1,25(OH)_2D_3$ та вітамін D-зв'язуючого білка (DBP) у сироватці крові дітей з інфекціями сечовидільної системи залежно від клінічної форми захворювання та встановити їх патогенетичну роль у розвитку інфекції сечовивідних шляхів. **Матеріали та методи.** Групи дослідження становили 84 дитини (середній вік — 10,0 ± 1,3 року). Основну групу розділили на підгрупи: 1-ша — 17 дітей, хворих на гострий пієлонефрит, 2-га — 21 пацієнт із хронічним пієлонефритом, 3-тя — 16 дітей, хворих на гострий цистит, 4-та — 10 пацієнтів із неуточненими інфекціями сечовидільної системи. Контрольну групу становили 20 умовно здорових дітей. Досліджували вміст $1,25(OH)_2D_3$ та DBP методом імуноферментного аналізу. **Результати.** Встановлено, що розвиток запального процесу в сечовивідних шляхах супроводжувався статистично значущим ($p < 0,01$) зниженням рівня $1,25(OH)_2D_3$ у сироватці крові дітей основної групи порівняно з контрольною. Уміст $1,25(OH)_2D_3$ у пацієнтів усіх підгруп був достовірно нижчим за показники контрольної групи ($p < 0,01$), проте без статистичної різниці. Рівень DBP у сироватці крові дітей основної групи був статистично значуще ($p < 0,05$) підвищеним порівняно з контрольною, але статистично значущої різниці між підгрупами, що досліджувалися, ми не виявили. **Висновки.** Розвиток гострого запального процесу в сечовивідних шляхах у дітей відбувається на тлі статистично значущого зниження рівня $1,25(OH)_2D_3$ у сироватці крові в поєднанні з високими рівнями вітамін D-зв'язуючого білка. Це виступає патогенетичним підгрунтям необхідності розробки терапевтичних і профілактичних схем призначення вітаміну D дітям з інфекціями сечовидільної системи.

Ключові слова: діти; інфекція сечовивідних шляхів; вітамін D; вітамін D-зв'язуючий білок