ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8

International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

Correction of Vitamin D Levels in Patients with Diagnosed Chronic Kidney Disease

Svetlana Andreevna Karakulova[1], Aslan Anzorovich Sapiev[2], Amiliya Poladovna Nametullaeva[3], Esiat Abubakarovna Mezhidova[4], Sarvar Sayd ogly Ragibov[2], Murad Aslambekovich Khasanov[4], Madina Elbrusovna Adzhieva[5], Naida Khizrievna Nazarova[5], Maryam Muradovna Ismailova[5], Alina Yurievna Maslova[1,6]

[1]Stavropol State Medical University, Stavropol, RUSSIA.
[2]Rostov State Medical University, Rostov-on-Don, RUSSIA.
[3]Moscow State University of Medicine and Dentistry, Moscow, RUSSIA.
[4]Chechen State University named after A. A. Kadyrov, Grozny, Republic of Chechnya, RUSSIA.
[5]Dagestan State Medical University, Makhachkala, Republic of Dagestan, RUSSIA.
[6]Socmedica, Skolkovo, Moscow, RUSSIA.
**Corresponding Author (Tel: +79183500889, Email: ruslankalmykov777@yandex.ru).*

Paper ID: 13A8U

Volume 13 Issue 8

Received 04 March 2022
Received in revised form 04 June 2022
Accepted 11 June 2022
Available online 18 June 2022

Keywords:
Vitamin D; Vitamin D deficiency; Chronic kidney disease; Calcitriol

Abstract

Vitamin D deficiency in the population causes increased attention from doctors around the world. As a result of numerous studies, it has been revealed that vitamin D deficiency is widespread: it is detected in different age groups, in different countries. Active study of vitamin D allowed us to learn about its numerous functions and versatile effects on the body: it affects the cardiac and skeletal muscles, the health of the skin and the nervous system. It contributes not only to the full development of human organs but also protects against numerous diseases. Doctors and scientists have found that vitamin D affects the rate of development of chronic kidney disease. In patients diagnosed with chronic kidney disease, there is a decrease in calcitriol production, which leads to the risk of developing nephrosclerosis and hypertension. At the same time, it is very difficult to identify a deficiency of this vitamin due to a low-symptomatic course of the disease or atypical. For the primary prevention of many diseases, including kidney diseases, it is necessary to conduct timely screening of vitamin D deficiency.

Disciplinary: Medicine, Therapy.

Cite This Article:

Karakulova, S.A., Sapiev, A.A., Nametullaeva, A.P., Mezhidova, E.A., Ragibov, S.S., Khasanov, M. A., … Maslova, A.Yu. (2022). Correction of Vitamin D Levels in Patients with Diagnosed Chronic Kidney Disease. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 13*(8), 13A8U, 1-7. http://TUENGR.COM/V13/13A8U.pdf DOI: 10.14456/ITJEMAST.2022.168

1 Introduction

Recently, there has been an active interest of scientists in vitamin D. This vitamin plays an important role in the regulation of many hormonal and metabolic effects of the body, which makes the problem of studying it one of the most urgent for healthcare [1].

Vitamin D was discovered by scientists at the beginning of the XX century, but after studying its effects on the body in the 70s, attention to it only intensified [2-4].

The norm is the optimal concentration of vitamin D in the blood of an adult of 30-100 ng/ml, insufficiency of 20-30 ng/ml, deficiency – less than 20 ng/ml [5,6].

Chronic kidney disease is a serious problem for medicine and healthcare in many countries. This is a disease in which the kidneys gradually lose their functionality for several months or years [7].

According to researchers, about 10% of the population suffers from chronic kidney disease, while in various countries the incidence of diseases is approximately equal [8,9].

Studies in this field state that chronic kidney disease is registered in approximately 1/3 of patients with chronic heart failure, and this disease is also common in people in the older age group (about 36%) [10,11].

Such an extensive spread of chronic kidney disease worsens the quality of life of the population, especially older people.

2 Vitamin D Deficiency in Chronic Kidney Disease

Vitamin D deficiency is widespread in patients with chronic kidney disease [12,13]. Among the numerous reasons, the following can be distinguished:

- unbalanced nutrition;
- lack of sunlight;
- violation of the synthesis and metabolism of vitamin D, etc.

Vitamin D enters the body in various ways. The first is with food, with this method the body receives ergocalciferol (D2) from plant sources, and cholecalciferol (D3) from animals. The second method is produced in the skin under the action of ultraviolet light. Regardless of the way vitamin D enters the body, its further transportation takes place with the help of a D-binding protein to the liver, where it undergoes hydroxylation with 25-hydroxylase, turning into 25-hydroxyvitamin D (25 (OH)D). The resulting compound is the main circulating form of vitamin D [14,15].

After the second hydroxylation, a new active form is formed, which is called D-hormone (calcitriol). The main source of circulating calcitriol is the kidneys, and when they are ill, vitamin D is excreted in the urine, which leads to a decrease and loss of calcitriol in the blood. D-hormone is considered one of the main hormonal forms of vitamin D and performs many functions (stimulation of calcium absorption in the intestine, regulating the bone formation, participation in the production of various proteins, etc.).

Due to chronic kidney disease, vitamin synthesis decreases, which leads to disruption of the full functioning of the body, and dysfunction of systems [16,17].

The deficiency of active vitamin D in combination with high levels of calcium and phosphates leads to secondary hyperparathyroidism – a disease of the parathyroid glands. About 30% of hemodialysis patients suffer from this severe pathology.

Researchers have found that in chronic kidney disease, vitamin D deficiency can be detected at an early stage of the disease.

An important role in the development and progression of chronic kidney disease is played by the renin-angiotensin-aldosterone system, which contributes to the development of proteinuria, nephrosclerosis, and hypertension. Vitamin D, in turn, suppresses the hyperproduction of renin and, thereby, the activity of the renin-angiotensin-aldosterone system. With vitamin D deficiency, nephrosclerosis may develop [18].

Thanks to modern research, it has been established that the amount of vitamin D in the human body affects the rate of development of chronic kidney disease. That is why it is advisable to include correction of vitamin D deficiency in the treatment regimen of chronic kidney disease.

3 Correction of Vitamin D Levels in Chronic Kidney Disease

In earlier methods of treatment of chronic kidney disease, it was believed that it was optimal to start treatment with vitamin D after the start of dialysis, but now scientists come to a different conclusion: to start treatment at the predialysis stages [19,20]. This will help to reduce the development of renal and cardiovascular complications, thereby improving the quality and prolonging the life of patients.

Early treatment with vitamin D in the predialysis stages allows you to delay the start of dialysis. If treatment begins at the stage of dialysis, then this reduces the number of fatal cases.

The inactive form of vitamin D, which enters the human body with food, is transformed in healthy kidneys into an active form that can be used by the body in various biochemical processes [21-23]. In patients with renal insufficiency, the kidneys cannot convert vitamin D and therefore, in order to avoid its deficiency, patients should receive an already activated form of this vitamin [24,25].

At the end of the XX century, clinical studies were conducted in North America, during which the following results were obtained: patients receiving active vitamin D had lower mortality compared to those who did not receive it. And this decrease was more than 20%, regardless of the age of patients and concomitant diseases [26,27].

In the course of the research, a positive effect of the use of vitamin D in the treatment of chronic kidney disease has been established. The mechanisms of calcitriol anti-inflammatory action, inhibition of mesangial cell and podocyte proliferation, reduction of renin-angiotensin system activity, prevention of glomerular hypertrophy, reduction of proteinuria, production of fibrogenic cytokines, blockade of epithelial-mesenchymal transformation and activation of myofibroblasts were established [28]. Due to these effects, calcitriol inhibits the progression of glomerular and tubulointerstitial fibrosis and thereby slows down the progression of chronic kidney disease [29,30].

When prescribing vitamin D for treatment, one should take into account the fact that for adults and the elderly, a decrease in renal calcitriol production is characteristic. This is due to a reduction in sunlight exposure and, as a result, a decrease in vitamin D activity in the skin.

For medicine, one of the promising directions in slowing the progression of nephropathy of any genesis is the activation of vitamin D receptors [31].

4 Conclusion

This study reviews the relationship between chronic kidney disease and vitamin D. Chronic kidney disease is the most common disease along with diabetes mellitus and hypertension. It occurs equally often both in countries with a high standard of living and in developing countries.

Scientists and doctors from all countries note the ubiquity of vitamin D deficiency, regardless of the age of people, concomitant diseases, as well as the geography of residence.

The problem of vitamin D deficiency is becoming multidisciplinary, which requires the development of new ways of treatment.

Due to numerous studies on the role of vitamin D in the functioning of the body, as well as its effect on the course of chronic kidney disease, the use of vitamin (correction) is recommended to be prescribed even at the initial stages of the disease. Such treatment will prevent the development and active progression of the disease.

5 Availability of Data and Material

Data can be made available by contacting the corresponding author.

6 References

[1] Chau YY, Kumar J. Vitamin D in chronic kidney disease. Indian J Pediatr. 2012;79(8):1062-8. DOI: 10.1007/s12098-012-0765-1

[2] Pludowski P, Jaworski M, Niemirska A, Litwin M, Szalecki M, Karczmarewicz E, Michalkiewicz J. Vitamin D status, body composition and hypertensive target organ damage in primary hypertension. J Steroid Biochem Mol Biol. 2014;144 Pt A:180-4. DOI: 10.1016/j.jsbmb.2013.10.026

[3] Kostrova GN, Malyavskaya SI, Lebedev AV. [Vitamin D deficiency and carbohydrate metabolism in obese children and adolescents]. Vopr Pitan. 2021;90(1):57-64. Russian. DOI: 10.33029/0042-8833-2021-90-1-57-64.

[4] Shahida Anusha Siddiqui, Nur Alim Bahmid, Ahmed Taha, Ibrahim Khalifa, Sipper Khan, Hadis Rostamabadi & Seid Mahdi Jafari (2022) Recent advances in food applications of phenolic-loaded micro/nanodelivery systems, Critical Reviews in Food Science and Nutrition, DOI: 10.1080/10408398.2022.2056870

[5] Nitta K, Ogawa T, Hanafusa N, Tsuchiya K. Recent Advances in the Management of Vascular Calcification in Patients with End-Stage Renal Disease. Contrib Nephrol. 2019;198:62-72. DOI: 10.1159/000496532

[6] Bikle DD. Vitamin D: Production, Metabolism and Mechanisms of Action. 2021 Dec 31. In: Feingold KR, Anawalt B, Boyce A, Chrousos G, de Herder WW, Dhatariya K, Dungan K, Hershman JM, Hofland J, Kalra S, Kaltsas G, Koch C, Kopp P, Korbonits M, Kovacs CS, Kuohung W, Laferrère B, Levy M, McGee EA, McLachlan R, Morley JE, New M, Purnell J, Sahay R, Singer F, Sperling MA, Stratakis CA, Trence DL, Wilson DP, editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, 2000.

[7] Rauf A, Abu-Izneid T, Olatunde A, Ahmed Khalil A, Alhumaydhi FA, Tufail T, Shariati MA, Rebezov M, Almarhoon ZM, Mabkhot YN, Alsayari A, Rengasamy KRR. COVID-19 Pandemic: Epidemiology, Etiology,

Conventional and Non-Conventional Therapies. *International Journal of Environmental Research and Public Health*. 2020; 17(21):8155. DOI: 10.3390/ijerph17218155

[8] Ketteler M, Block GA, Evenepoel P, Fukagawa M, Herzog CA, McCann L, Moe SM, Shroff R, Tonelli MA, Toussaint ND, Vervloet MG, Leonard MB. Executive summary of the 2017 KDIGO Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD) Guideline Update: what's changed and why it matters. Kidney Int. 2017;92(1):26-36. DOI: 10.1016/j.kint.2017.04.006.

[9] Zimmerman, T.; Siddiqui, S.A.; Bischoff, W.; Ibrahim, S.A. Tackling airborne virus threats in the food industry: A proactive approach. Int. J. Environ. Res. Public Health 2021, 18, 4335

[10] Chowdhury R, Peel NM, Krosch M, Hubbard RE. Frailty and chronic kidney disease: A systematic review. Arch Gerontol Geriatr. 2017;68:135-142. DOI: 10.1016/j.archger.2016.10.007.

[11] Ayivi R, Ibrahim S, Colleran H, Silva R, Williams L, Galanakis C, Fidan H, Tomovska J and Siddiqui SA. COVID-19: human immune response and the influence of food ingredients and active compounds. Bioactive Compounds in Health and Disease. 2021;4(6):100

[12] Rozita M, Noorul Afidza M, Ruslinda M, Cader R, Halim AG, Kong CT, Nor Azmi K, Shah SA. Serum Vitamin D levels in patients with chronic kidney disease. EXCLI J. 2013 11;12:511-20.

[13] Tatamov AA, Boraeva TT, Revazova AB, Alibegova AS, Dzhanaralieva KM, Tetueva AR, Yakubova LA, Tsoma MV, Mishvelov AE, Povetkin SN. Application of 3D Technologies in Surgery on the Example of Liver Echinococcosis. Journal of Pharmaceutical Research International, 2021; 33(40A):256-261. DOI: 10.9734/jpri/2021/v33i40A32242

[14] Marcinowska-Suchowierska E, Kupisz-Urbańska M, Łukaszkiewicz J, Płudowski P, Jones G. Vitamin D Toxicity-A Clinical Perspective. Front Endocrinol (Lausanne). 2018;9:550. DOI: 10.3389/fendo.2018.00550.

[15] Gutnova, T. S., Kompantsev, D. V., Gvozdenko, A. A., Kramarenko, V. N., & Blinov, A. V. Vitamin D nanocapsulation. IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENII KHIMIYA KHIMICHESKAYA TEKHNOLOGIYA, 2021;64(5), 98-105. DOI: 10.6060/ivkkt.20216405.6399

[16] Jean G, Souberbielle JC, Chazot C. Vitamin D in Chronic Kidney Disease and Dialysis Patients. Nutrients. 2017;9(4):328. DOI: 10.3390/nu9040328.

[17] Siddiqui SA, Ali Redha A, Snoeck ER, Singh S, Simal-Gandara J, Ibrahim SA, Jafari SM. Anti-Depressant Properties of Crocin Molecules in Saffron. Molecules. 2022; 27(7):2076. DOI: 10.3390/molecules27072076

[18] Cannata-Andía JB, Martín-Carro B, Martín-Vírgala J, Rodríguez-Carrio J, Bande-Fernández JJ, Alonso-Montes C, Carrillo-López N. Chronic Kidney Disease-Mineral and Bone Disorders: Pathogenesis and Management. Calcif Tissue Int. 2021;108(4):410-422. DOI: 10.1007/s00223-020-00777-1

[19] Milovanova LIu, Dobrosmyslov IA, Milovanov IuS. [Experience with active vitamin D metabolites in phosphorus-calcium metabolic disorders in patients with predialysis chronic kidney disease]. Ter Arkh. 2014;86(6):52-6. Russian.

[20] Blinov A.V. (2018). Comparison of the zeta-potential measuring methods accuracy for the colloidal particles. Physical and Chemical Aspects of the Study of Clusters Nanostructures and Nanomaterials. 10:115-123

[21] Siddiqui Shahida, Pahmeyer Maximilian, Assadpour Elham, Jafari Seid. (2022). Extraction and purification of d-limonene from orange peel wastes: Recent advances. Industrial Crops and Products. 177. 114484. DOI: 10.1016/j.indcrop.2021.114484.

[22] Siddiqui, S.A., Pahmeyer, M.J., Mehdizadeh, M., Nagdalian, A.A., Oboturova, N.P., Taha, A. (2022). Consumer Behavior and Industry Implications. In: Galanakis, C.M. (eds) The Age of Clean Label Foods. Springer, Cham. DOI: 10.1007/978-3-030-96698-0_7

[23] Rzhepakovsky IV, Areshidze DA, Avanesyan SS, Grimm WD, Filatova NV, Kalinin AV, Kochergin SG, Kozlova MA, Kurchenko VP, Sizonenko MN, Terentiev AA, Timchenko LD, Trigub MM, Nagdalian AA, Piskov SI. Phytochemical Characterization, Antioxidant Activity, and Cytotoxicity of Methanolic Leaf Extract of *Chlorophytum Comosum* (Green Type) (Thunb.) Jacq. *Molecules*. 2022; 27(3):762. DOI: 10.3390/molecules27030762

[24] Kestenbaum B, Belozeroff V. Mineral metabolism disturbances in patients with chronic kidney disease. Eur J Clin Invest. 2007;37(8):607-22. DOI: 10.1111/j.1365-2362.2007.01840.x.

[25] Kalantar-Zadeh K, Hollenbeak CS, Arguello R, Snyder S, Ashfaq A. The cost-effectiveness of extended-release calcifediol versus paricalcitol for the treatment of secondary hyperparathyroidism in stage 3-4 CKD. J Med Econ. 2020;23(3):308-315. DOI: 10.1080/13696998.2019.1693385.

[26] Mazzaferro S, Goldsmith D, Larsson TE, Massy ZA, Cozzolino M. Vitamin D metabolites and/or analogs: which D for which patient? Curr Vasc Pharmacol. 2014;12(2):339-49. DOI: 10.2174/15701611113119990024

[27] Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Update Work Group. KDIGO 2017 Clinical Practice Guideline Update for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). Kidney Int Suppl (2011). 2017;7(1):1-59.

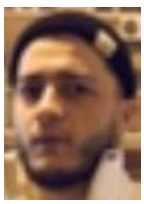
[28] Rzhepakovsky I, Anusha Siddiqui S, Avanesyan S, Benlidayi M, Dhingra K, Dolgalev A, Enukashvily N, Fritsch T, Heinz V, Kochergin S, Nagdalian A, Sizonenko M, Timchenko L, Vukovic M, Piskov S, Grimm WD. Anti-arthritic effect of chicken embryo tissue hydrolyzate against adjuvant arthritis in rats (X-ray microtomographic and histopathological analysis). Food Sci Nutr. 2021;9(10):5648-5669. DOI: 10.1002/fsn3.2529

[29] Bilezikian JP, Formenti AM, Adler RA, Binkley N, Bouillon R, Lazaretti-Castro M, Marcocci C, Napoli N, Rizzoli R, Giustina A. Vitamin D: Dosing, levels, form, and route of administration: Does one approach fit all? Rev Endocr Metab Disord. 2021;22(4):1201-1218. DOI: 10.1007/s11154-021-09693-7

[30] Tovlahanova TJH et al. Study of the Effect of the Image Scanning Speed and the Type of Conductive Coating on the Quality of Sem-Micrographs of Oxide Nano Materials for Medical Use. Ann Med Health Sci Res. 2021;11:S3:60-64

[31] Maslova AY, Bazaeva KL, Abdullaeva ZA, Khazamova SO, Zeusheva KA, Grechkina TA, Semkina EN, Abramov MA, Mishvelov AE, Povetkin SN. Astrocytes and their Phenomenal Possibilities in the Treatment of Various Neurodegenerative Disorders: An Overview. Journal of Pharmaceutical Research International. 2021;33(33A): 60-68. DOI: 10.9734/jpri/2021/v33i33A31772

Svetlana Andreevna Karakulova is a student of Stavropol State Medical University, Stavropol, Russia.



Aslan Anzorovich Sapiev is a Student of Rostov State Medical University, Rostov-on-Don, Russia

Amiliya Poladovna Nametullaeva is a student at Moscow State University of Medicine and Dentistry, Moscow, Russia

Esiat Abubakarovna Mezhidova is a student of Chechen State University named after A. A. Kadyrov, Grozny, Republic of Chechnya, Russia

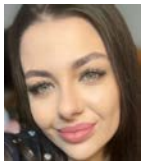
Sarvar Sayd ogly Ragibov is a Student of Rostov State Medical University, Rostov-on-Don, Russia.

Murad Aslambekovich Khasanov is a student of Chechen State University named after A. A. Kadyrov, Grozny, Republic of Chechnya, Russia

Madina Elbrusovna Adzhieva is a student of Dagestan State Medical University, Makhachkala, Republic of Dagestan, Russia

Naida Khizrievna Nazarova is a student of Dagestan State Medical University, Makhachkala, Republic of Dagestan, Russia

Maryam Muradovna Ismailova is a student of Dagestan State Medical University, Makhachkala, Republic of Dagestan, Russia.



Alina Yurievna Maslova is a junior researcher at the Pharmacological Laboratory of Stavropol State Medical University, Stavropol, Russia. Medical Expert, Socmedica, Skolkovo, Moscow, Russia