Short Communication

Changes in the Level of Vitamin D3 and Calcium in Patients with Chronic Kidney Disease

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Abstract

Background: Chronic kidney disease (CKD) is a global public health issue that is linked to a variety of anomalies in biology and hematology, resulting in increased mortalities and morbidity. **Objectives:** Aim of this study was to estimate the vitamin D3 and calcium with other parameters in people with CKD. **Materials and Methods:** Fifty male patients and 40 healthy men were included, and the age of the participants in this study ranged from 40 to 50 years old. Samples were collected during the period from November 2022 to December 2022. **Results:** The result showed a significant decrease in vitamin D3 and calcium in patients group 16.99 ± 3.84 ng/mL and 6.23 ± 0.39 mg/dL, respectively, compared with healthy group 35.50 ± 5.93 ng/mL and 9.46 ± 0.58 mg/dL, respectively, a significant rise in the urea, creatinine and uric acid levels in patients 223.90 ± 46.40 mg/dL, 12.01 ± 2.01 mg/dL, and 9.34 ± 0.90 mg/dL, respectively, compared with healthy group 25 ± 5.75 mg/dL, 0.67 ± 0.22 mg/dL, and 4.72 ± 0.85 mg/dL, respectively. **Conclusions:** Results showed reduced concentrations of vitamin D3 and calcium, and elevated in concentrations of urea, creatinine, and uric acid in patients.

Keywords: Calcium, chronic kidney disease, vitamin D3

Introduction

Vitamin D3 is a fat-soluble vitamin. It is a secosteroid with an endocrine mechanism of action produced sequentially in the epidermis, liver, and kidneys of humans.[1] There are two main forms of vitamin D; vitamin D2 (ergocalciferol, primarily human-made and added to meals) and vitamin D3 (cholecalciferol, mainly human-made and added to foods) (cholecalciferol, which is synthesized in the skin from 7-dehydrocholesterol).[1-3] Lack of vitamin D3 can be resulting in osteoporosis, diabetes, cancer, hypertension, obesity, fibromyalgia, depression, Alzheimer's disease, stroke, heart disease, autoimmune diseases, and periodontal disease. With the belief that vitamin D3 plays an important function in controlling the immune system, there is a possibility of reducing one's risk of autoimmune diseases and cancers.[4-6]

Vitamin D3 is a key calcium and phosphate homeostasis regulator.[7] Its activities on the gut, bone, kidney, and parathyroid help to keep calcium and phosphate in the blood. Vitamin D3 promotes calcium absorption in duodenum and phosphate absorption in the jejunum and ileum in the small intestine.[8]

The Ca^{2+} is a crucial regulator of numerous cellular functions, including stimulus-secretion coupling, enzyme activity, and muscle contraction.[9] Another intracellular messenger of hormone action is $Ca2^{+}$. The intestine, bone, and kidney are the key organs involved in maintaining calcium homeostasis in the body.[4,9]

Chronic kidney disease (CKD) is a silent killer that manifests itself as a progressive decline of renal function, which usually as result in end-stage renal disease. CKD is a rapidly developing condition that affects about 12% of the adult population. The main danger factors for

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CKD are glomerulonephritis, urinary tract infection, kidney stones, autoimmune disease, and toxic effects of drugs.[10,11]

In CKD, the mineral metabolism is progressively altered, and vitamin D3 deficiency is common. Vitamin D3 levels in the blood appear to be inversely related to kidney function. Vitamin D3 insufficiency has been linked to worsening renal function, as well as increased disease and death, in patients with CKD.[7,11]

CKD is one of the disorders that afflict our society, and vitamin D deficiency is a common health problem in our society. So, the study's purpose is to assess levels of vitamin D3 and calcium in patients with CKD.

Materials and Methods

Study design

The study included 90 samples, 50 patients were men and 40 healthy males, the participants in this study ranged in age from 40 to 50 years old.

Sample collection

From the patients having CKD, 50 blood samples were collected, from the Yarmouk medical laboratory in Tikrit city, with ages ranging between (40 and 50) years, and forty blood samples for healthy males as a control group of the same ages. Samples were collected during the period from November 2022 to December 2022.

Blood collection

During sample collection and serum preparation, 5 mL of venous blood was drawn to obtain blood samples using a disposable syringe and placed in a sterile test tube with a tight cover and left the tube at room temperature until clotting occurred. It was then placed in a centrifuge for 15 min at a speed of 5000×*g*. The serum was withdrawn with a micropipette and placed in a clean and sterile tube and kept in a state of freezing at a temperature of -20°C until performing biochemical analysis.

Biochemical parameters analyses

The vitamin D3 was determined using the enzyme-linked immunosorbent assay (ELISA), vitamin D3 kit was prepared by Lotus Global Co Ltd. (London). Calcium, creatinine, uric acid and urea kits prepared by Biolabo (France), and they were determined by the German company Roche's Cobas Integra 400 puls system self-analyzing instrument.

Statistical analysis

The statistical analysis was carried out using a *T*-test at the probability at $P \leq 0.05$ level, the results were communicated by the mean ± standard deviation (SD).

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number2048 and the date in October 25, 2022 to get this approval.

Results

The kidneys' capacity to yield active vitamin D is reduced in people with CKD, when body does not get enough active vitamin D, the body does not absorb as much calcium from your meals, which will result your blood calcium levels to drop. Additionally, excess phosphorus in CKD patients' blood may bind to calcium in the blood. As a result, serum calcium may decrease.

The results shown in Figure 1 indicate to the mean ± SD levels of vitamin D3 and calcium measured in the patients and healthy groups. The findings displayed a significant decline in the concentrations of vitamin D3 and calcium in patients 16.99 ± 3.84 ng/mL and 6.23 ± 0.39 mg/dL respectively compared with control group 35.50 ± 5.93 ng/mL and 9.46 ± 0.58 mg/dL, as shown in Figure 1.

According to the findings in Table 1, the patients and healthy groups mean ± SD values of urea, creatinine, and uric acid.

The results showed that the urea level increased significantly at 223.90 ± 46.40 mg/dL in patients compared with 25 ± 5.75 mg/dL in the control group, a significant increase in patients caused by CKD. Creatinine level was increased significantly at 12.01 ± 2.01 mg/dL patients compared with 0.67 ± 0.22 mg/dL as a control group. The level of uric acid increased significantly at 9.34 ± 0.90 mg/dL patients compared with 4.72 ± 0.85 mg/dL in the control group. That mean is a significant increase and it is related to a positive relationship with blood urea.

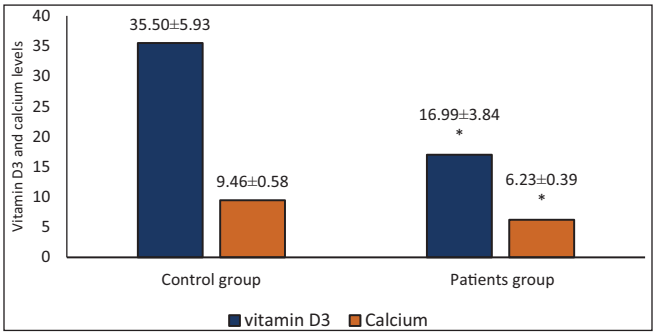

Figure 1: Vitamin D3 and calcium levels in patients control group. * At $P = 0.05$, this sign indicates a distinct significant value

Table 1: Concentration of urea, creatinine, and uric acid in patients and healthy groups

Parameters	Control	Patients	$P \leq 0.05$
Urea (mg/dL)	25 ± 5.75	223.90 ± 46.40*	$P < 0.013$
Creatinine (mg/dL)	0.67 ± 0.22	12.01 ± 2.01*	$P < 0.024$
Uric acid (mg/dL)	4.72 ± 0.85	9.34 ± 0.90*	$P < 0.32$

*At P 0.05, this sign indicates a distinct significant value

Discussion

Severe vitamin D insufficiency is extremely common in patients with CKD, and it is made worse by a decreased body's capacity to convert 25-(OH)vitamin D into 1,25 dihydroxy-vitamin D, the active form compared with healthy people.[12] Vitamin D insufficiency is common in CKD and is associated with the rising PTH that increases as renal function declines. Additionally, it can increase the danger of mineral bone disease, hyperparathyroidism, and heart disease.[13] A significant decrease in the vitamin D3 level in patients a reduction in renal 1- α- hydroxylase activity, which converts 25-hydroxy vitamin D to its active form, causes this condition. Many studies observed a low vitamin D3 and calcium concentrations in CKD patients, this is consistent with reported studies.[14,15]

Low concentration of 1,25(OH)2 D3 could be due to a variety of circumstances, involving reduced nutritional consumption and sun exposure, as well as insufficient synthesis in the skin after exposure to ultra violet B radiation.[16] In the general population, down 1,25(OH)2 D3 concentration take also been associated to cardiovascular, hypertension, peripheral vascular disease, and congestive heart failure.[17] Patients with little vitamin D concentration due to a scarcity of sun exposure or poor nutrition could potentially bias all vitamin D investigations.[18,19]

Calcium in CKD is a source of much dispute and misunderstanding; however, it is generally known that as kidney disease advances, the kidneys lose their ability to promote calcium excretion in the urine, and this could disrupt the process that keeps calcium from growing in CKD patients. However, as CKD develops, calcium levels decline, as calcium might be absorbed and missing throughout the gastrointestinal system, intestinal keep absorption becomes more reliant on the good gradient to maintain neutral disguise.[20]

Hypocalcemia in the parathyroid glands due to hyperphosphatemia associated with CKD, as well as a reduce in different calcium detecting receptors and fat-soluble vitamin D receptors. Furthermore, a lack of 1, 25 dihydroxycholecalciferol, or calcitriol, an active form of vitamin D3 allows the intestine to absorb dietary calcium.[21,22]

Singh and Bhatta[22] conducted a similar investigation, finding significant hypocalcemia in CKD patients compared to controls. In their investigation, Akman *et al*.,[23] discovered comparable outcomes, including a decrease in calcium levels.

Kidneys maintain homeostasis by continuously processing plasma through filtration, reabsorption, and release of chemicals, hence assisting in the preservation of the body's internal environment, renal impairment lowers the kidneys' glomerular filtration capacity, resulting in higher metabolic byproduct levels in the blood.[22]

CKD is characterized by a step-by-step reduction in glomerular filtration rate (GFR), resulting in a buildup of nitrogenous components in the blood; for example, creatinine and urea.[23]

In clinical settings, urea, a byproduct of protein metabolism, is frequently utilized as a proxy for the severity of CKD and the sufficiency of dialysis. Urea was thought to be a relatively innocuous, non-toxic chemical for a very long time. However, urea is a known direct and indirect uremic toxin, and clinical settings frequently use serum creatinine or urea to assess kidney function. Healthy kidneys filter urea nitrogen out of your blood and it leaves your body through your urine, this process helps keep your BUN level within a normal range.[24,25]

These findings are consistent with many studies,[22,23,26-29] which indicated higher levels of urea, creatinine, and uric acid in inpatients compared with control group. Renal failure can also be indicated by elevated urea levels in the blood.[30] The accretion of creatinine and urea in the blood of patients with CKD causes the body's extreme illness to be expelled from the bloodstream via the kidneys.[31]

Conclusions

In summary, Vitamin D3 and calcium are an essential to maintain good health and normal cellular physiology; patients with CKD have an exceptionally high rate of severe vitamin D deficiency that is further exacerbated by the reduced ability to convert 25-(OH) vitamin D into the active form, 1,25 dihydroxy-vitamin D. Taking into account the findings of this study, results showed decreased in the concentrations of vitamin D3 and calcium, and increased in concentrations of urea, creatinine, and uric acid in CKD patients.

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Conflicts of interest

There are no conflicts of interest.

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