Original Article

A Comparative Study of 25-Hydroxyvitamin D Level and Associated Parameters in chronic kidney disease (CKD) and Dialysis Patients in Shiraz, Iran

Elham Rostami[1], Zakieh Sadat Sheikhalishahi[2], Vahideh behmard[3], Mohammad Panji[4], Fatemeh Sadat Moravej[5], Amin Namdari[6], Sina Dalvand[7], Azita Aliakbarniya[8], Negar Yavari[9], Vajiheh Najafi[10]*

1. Department of Biology, School of Science, Shahid Chamran University of Ahvaz, Ahvaz, Iran.
2. Department of Physiology, Faculty of Medicine, Shahid Sadoughy University of Medical Sciences, Yazd, Iran.
3. Student Research Committee, Department of Midwifery, School of medical, Gonabad University of Medical Sciences, Gonabad, Iran.
4. Department of Cell and Molecular Biology, Faculty of Biological Science, Kharazmi University, Tehran, Iran.
5. Department of Biology, Payame Noor University, Isfahan, Iran.
6. Department of Clinical Biochemistry, Fasa University of Medical Sciences, Fars, Iran.
7. International Campus, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.
8. Department of Biology, Faculty of Life Sciences, Tonekabon Branch, Islamic Azad University, Mazandaran, Iran.
9. Department of Physiology, Isfahan University of Medical Science, Isfahan, Iran.
10. Research Center for Biochemistry and Nutrition in Metabolic Diseases, Kashan University of Medical Sciences, Kashan, Iran.

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Abstract

Background: Vitamin D deficiency and insufficiency are generally observed in chronic kidney disease (CKD) and dialysis patients. The goal of this work was to compare the serum levels of vitamin D and its-related metabolic parameters in CKD patients and hemodialysis patients. **Materials and Methods:** A total of 109 dialysis patients and 99 CKD patients who had not consumed vitamin D for ≥ 1 year were enrolled in this study. 25-Hydroxy vitamin D (25-(OH) D) levels, calcium, alkaline phosphatase (ALP), hemoglobin (Hb), hematocrit (HCT), total iron-binding capacity (TIBC), parathyroid hormone (PTH), and phosphorous were evaluated in the serum of the patients. **Results**: 25-(OH) D levels in patients with CKD and dialysis patients were 31.73±13.34 ng/mL and 15.52±5.36 ng/mL, respectively. The levels of calcium (P=0.000), ALP (P=0.006), 25(OH) D (P=0.000), FBS (P=0.000), Hb (P=0.002), HCT (P=0.002), and TIBC (P=0.000) were significantly higher, and the levels of PTH (p=0.000) and phosphorous (P=0.000) were significantly lower in the CKD group compared to dialysis group. **Conclusion:** The 25-(OH) Vitamin D levels and its metabolic parameters except PTH and phosphorus are lower in patients on dialysis compared with the patients with CKD.

Keywords*:* Calcium, Chronic kidney disease, Dialysis, 25-(OH) D, Parathyroid hormone.

***Corresponding Author:** Vajiheh Najafi, Address: Research Center for Biochemistry and Nutrition in Metabolic Diseases, Kashan University of Medical Sciences, Kashan, Iran. Email: v.najafi2013@gmail.com, Tel:+989197107627.

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Introduction

Chronic kidney disease (CKD) is a severe public health problem, which its prevalence in various populations is 10% to 12% and rises with increasing age (1). Alteration in levels of calcium, phosphorus, alkaline phosphatase (ALP), and parathyroid hormones (PTH) are a common manifestation in

patients with CKD who are receiving dialysis therapy. They may be associated with poor outcomes, including the increased risk of bone fracture and cardiovascular mortality in these patients (2, 3). CKD is also characterized as a state of vitamin D deficiency, and many interventional studies in CKD patient populations have shown an association between low vitamin D levels and poor outcomes in the CKD patients (4, 5). Vitamin D is a nutritional hormone involved in bone metabolism, calcium and phosphorus homeostasis, and PTH regulation (6). The measurement of 25-hydroxyvitamin D (25(OH)D) concentration is the best biomarker in serum to reflect the vitamin D status in the body (7, 8). The Kidney Disease Outcome Quality Initiative (KDOQI) guidelines recommend measuring the serum concentrations of 25(OH) D in CKD patients and, if <30 ng/ml replacing it with vitamin D (2). Caravaca-Fontán et al. reported that more than 80% of pre-dialysis patients had serum 25(OH) D level <20ng/mL (9). In addition to CKD, vitamin D deficiency is also associated with many disorders, including skeletal disorders, autoimmune diseases, hypertension, cardiovascular, and iron deficiency anemia. The low serum level of this hormone is typical among dialysis patients (7). A strong association between low vitamin D levels and morbidity and mortality in these patients has been reported (5). The administration of nutritional vitamin D supplements has been recommended as a strategy in patients with kidney disease (10). Some previous studies indicated that low levels of 25(OH)D had been associated with low levels of serum iron in patients with CKD. Indeed, Vitamin D deficiency was significantly associated with iron deficiency anemia in patients with CKD who did not require dialysis (11). However, 25(OH)D levels and serum markers related to mineral metabolism may be different in CKD and dialysis, and thus outcomes in these disorders are different. Thus, we conducted this study to compare the vitamin D levels and its related metabolic parameters between CKD patients and hemodialysis patients.

Methods

The present research was designed as a cross-sectional study. A total of 109 dialysis patients and 99 CKD patients at the Dialysis Department of Imam Reza Clinic in Shiraz were enrolled in the study, and the written consents were obtained for both patient groups. Fasting blood samples (10 ml) were taken and sent to the laboratory for measuring the serum levels of fasting blood sugar (FBS), 25(OH) D levels, phosphorus, calcium, ALP, hemoglobin (Hb), hematocrit (HCT), total iron-binding capacity (TIBC), PTH and Fe. Serum concentrations of ALP, calcium, and phosphorus were determined by the photometric method (Pars Azmun, Karaj, Iran). PTH was measured in the serum of the patients by a chemiluminescence method. 25-OH D was evaluated by the enzyme immunosorbent assay (EIA) method (Immunodiagnostic Systems, Paris, France). Patients with 25-OH D levels<10 ng/mL, 10-30 ng/mL, and 25-OH D levels>30 were categorized as vitamin D deficiency, insufficiency, and sufficiency, respectively. For statistical analysis, data were analyzed by SPSS, version 17.0 (SPSS Inc, Chicago, IL). Student –t-test and Mann-Whitney-U tests were used for quantitative variables and $p< 0.05$ were considered as statistically significant.

Results

In the current study, 208 subjects (45.2% men and 54.8% of women) were enrolled. All data are presented as mean ± SD. The mean age of 99 patients with CKD was 44.62±13.51, and the mean age of 109 dialysis patients were 59.36±13.04. The mean±SD of 25(OH) D, calcium, phosphorous, PTH, FBS, ALP, Hb, HCT, Fe, and TIBC in both CKD and dialysis groups are shown in Table 1. As shown in Table 1, there was statistically significant in the levels of calcium (P=0.000), phosphorous (P=0.000), ALP (P=0.006), 25(OH) D (P=0.000), PTH (p=0.000), FBS (P=0.000), Hb (P=0.002), HCT (P=0.002) and TIBC (P=0.000) between CKD patient and dialysis patient groups. Regarding the P, PTH, and FBS levels, the results showed a significant increase in the dialysis group compared to the CKD group. Besides, a significant increase in Ca, ALP, 25(OH) D, Hb, HCT, and TIBC were observed in CKD groups compared to the dialysis groups. Fe levels in dialysis patients were lower than CKD patient groups, but this difference was not statistically significant (P-Value = 0.83). As shown in Table 2, the prevalence rate of vitamin D insufficiency in the dialysis group was 91 (83.5%), and

in the CKD group were 47 (47.47%), respectively. Vitamin D deficiency, insufficiency, and sufficiency were defined with serum 25(OH)D<10 ng/ml, 10< 25(OH)D<30 ng/ml, and 25(OH)D ≥ 30 ng/ml, respectively. The prevalence rate of vitamin D insufficiency and deficiency in the dialysis group were 91(83.5%) and 18 (16.5%), respectively. The prevalence rate of vitamin D insufficiency and sufficiency in the dialysis group were 47(47.47%) and 52 (52.53%), respectively.

Table 1. The mean values of biochemical parameters calcium, phosphorus, PTH, 25-(OH) D, FBS, HCT, HB, Fe, and TIBC in the dialysis patients and CKD patients.

	Dialysis (n=109)	**CKD (n=99)**	
	mean±SD	mean±SD	P value
Age (years)	59.36±13.04	44.62±13.51	0.62
Calcium(mg/dl)	8.37±0.84	8.52±0.56	0.000
Phoshporus(mg/dl)	5.28±1.3	4.18±0.83	0.000
ALP (U/L	281.4±118.98	344.5±162.3	0.006
PTH(U/L	345.49±203.62	64.63±20.26	0.000
25(OH) D(ng/ml)	15.52±5.36	31.73±13.34	0.000
FBS (mg/dl)	99.23±23.07	87.04±7.61	0.000
Hb (g/dl)	9.41±1.20	13.87±1.47	0.002
HCT (%)	28.21±3.62	41.61±4.41	0.002
Fe (mcg/dL	39.94±14.83	92.27±15.18	0.83
TIBC (µg/dL	345.18±8.62	405.86±78.97	0.000

Table 2. The prevalence rate of vitamin D sufficiency, insufficiency, and deficiency in both CKD and dialysis groups.

	Dialysis(n=109)		**Chronic(n=99)**	
25(OH) D levels	mean±Sd	Number (%)	mean±SD	Number (%)
25(OH) D<10 ng/ml	8.18±0.51	18 (16.5%)	-----	---
10 <25(OH).D<10 ng/ml	16.97±4.64	91 (83.5%)	20.97±3.92	47 (47.47%)
25(OH).D≥ 30 ng/ml	----	----	41.46±11.18	52 (52.53%)

Discussion

In the present research, we reported that the serum levels of 25-(OH) D, calcium, phosphorous, ALP, PTH, FBS, Hb, HCT, and TIBC in patients with dialysis patients were significantly lower than in the CKD patients, but the serum levels of phosphorus, PTH and FBS were significantly higher in the dialysis group compared to the CKD group. There is a significant association between the Fe level in the CKD and dialysis patients.

Disorders associated with mineral and bone metabolism have a vital role in the CKD pathophysiology. ALP stimulates bone formation mainly through modulation of the balance between phosphate and pyrophosphate, and it is a well-recognized marker of bone turnover in patients with CKD and hemodialysis (1). Vitamin D is a steroid hormone that interacts with a specific nuclear receptor, vitamin D receptor (VDR), and plays an essential role in the regulation of calcium and phosphate homeostasis, muscular health, and bone metabolism (12). However, recent researches represent the pleiotropic effects of vitamin D as a result of the activation of the vitamin D receptor (VDR) in different organs in the body (12). Low 25(OH)D serum level is associated with various metabolic diseases like cardiovascular disease (CVD), osteoporosis, rickets, diabetes mellitus, hypertension, autoimmune diseases, renal disease, and some types of cancers (8, 13). Accumulating evidence indicated that there is a low serum level of 25(OH)D in 80% of patients with CKD (7). A meta-analysis of prospective studies demonstrated that higher 25(OH) D levels are associated with a significant decrease in mortality risk in patients with CKD (14). In 2015, Cankaya et al. showed that the serum levels of 25(OH)D is lower in hemodialysis

patients compared with CKD patients (6). Here, we analyzed serum levels of 25(OH)D and parameters associated with mineral metabolism in CKD patients and dialysis patients. The serum 25 (OH) D level was significantly lower in dialysis patients than CKD patients. All patients were divided into three categories: 25 (OH) D ≥30 as sufficient, 10<25 (OH) D <30 as insufficiency and 25 (OH) D <10 as deficiency. Our results also showed that phosphorus and PTH levels were significantly higher in the dialysis group compared to the CKD group. Besides, Ca and ALP were significantly lower in the dialysis group compared to the CKD group. Biochemical abnormalities of bone and mineral metabolisms have been associated with anemia in patients with CKD, mainly in hemodialysis patients (11). Recent studies are indicating an association in abnormalities of 25(OH)D with low hemoglobin (Hb) levels and serum iron in patients with CKD (11, 15). In 2017, Boronat M. et al. reported that the serum levels of calcium and phosphorus are strongly associated with anemia in patients with non-dialysis CKD (16). In our study, a significant increase in Hb and HCT were observed in CKD groups compared to the dialysis groups. Fe levels in dialysis patients were lower than CKD patient groups, but this difference was not statistically significant.

Conclusion

In conclusion, the findings of the current study suggested that the serum concentrations of 25-(OH) D and its-related metabolic parameters except PTH and phosphorus are lower in patients on dialysis compared with the patients with CKD.

Conflict of Interest

The authors declared no conflict of interest.

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