Evaluation of the Vitamin D level among CKD patients

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Abstract

Background: Approximately a little less than 20 percent of people worldwide are affected with chronic kidney disease (CKD). The body of research over the last ten years has shown that vitamin D is involved in a wide range of actions involving several regulatory mechanisms. The present investigation was therefore carried out to ascertain and evaluate the Vitamin D status in individuals with chronic renal disease in light of the aforementioned facts.

Materials & Methods: 120 patients with chronic kidney disease were enrolled. Venous blood drawn from the subjects following 12-14 hours fasting. Serum 25- OH vitamin D estimated by ELISA method. Serum urea, creatinine, calcium, phosphorus, and eGFR calculated by using Cockcroft – Gault formula. The data was entered into the Microsoft excel and the statistical analysis was performed by statistical software SPSS version 25.0.

Results: Mean age of the patients was 54.7 years. Mean serum vitamin D levels were found to be 22.58 ng/ml. Out of 120 patients, serum vitamin D levels were sufficient in 25.83 percent of the patients while they were insufficient in 35.83 percent of the patients. Mean serum vitamin D levels were deficient in 38.33 percent of the patients. According to CKD grading, 8.33 percent, 14.17 percent, 29.17 percent and 48.33 percent of the patients were of Grade 3a, Grade 3b, Grade 4 and Grade 5 respectively. While correlation of Vitamin D status and serum phosphate levels with CKD grading analyzing statistically, significant results were obtained.

Conclusion: It is still unknown whether vitamin D deficiency is the cause or only the consequence of various chronic diseases. Since these chronic diseases lack specific treatment or the treatment effects are not curative, strategies for the control of chronic diseases should focus on the prevention.

Key words: Vitamin D, Chronic kidney disease

Introduction

Approximately less than 20 percent of people worldwide are affected with chronic kidney disease (CKD), which is frequently overlooked by patients and medical professionals. The high prevalence, morbidity, and mortality of CKD make it a significant public health issue. India has around seventeen percent of the world's population on its three percent of land.[1- 3]

Many patients exhibit no symptoms or exhibit generalised symptoms like fatigue, itching, or loss of appetite. Diagnoses are frequently made when symptoms get worse or when screening procedures (such as blood or urine testing) yield unexpected results.[4- 6]

The body of research over the last ten years has shown that vitamin D is involved in a wide range of actions involving several regulatory mechanisms. Recent clinical investigations show that vitamin D therapy for CKD patients has benefits beyond its traditional function in the maintenance of bone and mineral metabolism, including decreased proteinuria and mortality. As a result, vitamin D analogues, such as paricalcitol, are becoming more and more recognised as possible therapeutic agents for improving clinical outcomes in patients with advanced renal disease.[5- 8] The present investigation was therefore carried out to ascertain and evaluate the Vitamin D status in individuals with chronic renal disease in light of the aforementioned facts.

Materials & methods

The total sample size was determined to be 120 patients with chronic kidney disease. After approval from the Institutional Ethical committee all patients were selected as per inclusion and exclusion criteria.

Inclusion criteria

1. Glomerular Filtrartion Rate (GFR)<60 ml/min
2. Age of 18 year or above
3. Patient who give informed consent.

Exclusion criteria

1. Patient not giving consent for the study
2. Pregnant women
3. Known Case of Ischemic heart disease
4. Patient having co existing liver disease
5. Taking Drugs that effect Vitamin D absorption and metabolism such as isoniazid, anticonvulsant, bisphosphonates , or taking vitamin D supplement.

A detailed history, complete physical examination and routine & appropriate investigations were done for all patients. Venous blood drawn from the subjects following 12-14 hours fasting. Serum 25- OH vitamin D estimated by ELISA method. The data was entered into the Microsoft excel and the statistical analysis was performed by statistical software SPSS version 25.0. The Quantitative (Numerical variables) were present in the form of mean and SD and the Qualitative (Categorical variables) were present in the form of frequency and percentage.

Results

Mean age of the patients was 54.7 years. 80 percent of the patients were males while the remaining were females. Mean serum calcium levels were found to be 9.85 mg/dL. Mean BUN levels were found to be 25.28 mg/dL. Mean serum phosphate levels were found to be 3.54 ng/ml. Mean serum vitamin D levels were found to be 22.58 ng/ml. Out of 120 patients, serum vitamin D levels were sufficient in 25.83 percent of the patients while they were insufficient in 35.83 percent of the patients. Mean serum vitamin D levels were deficient in 38.33 percent of the patients.

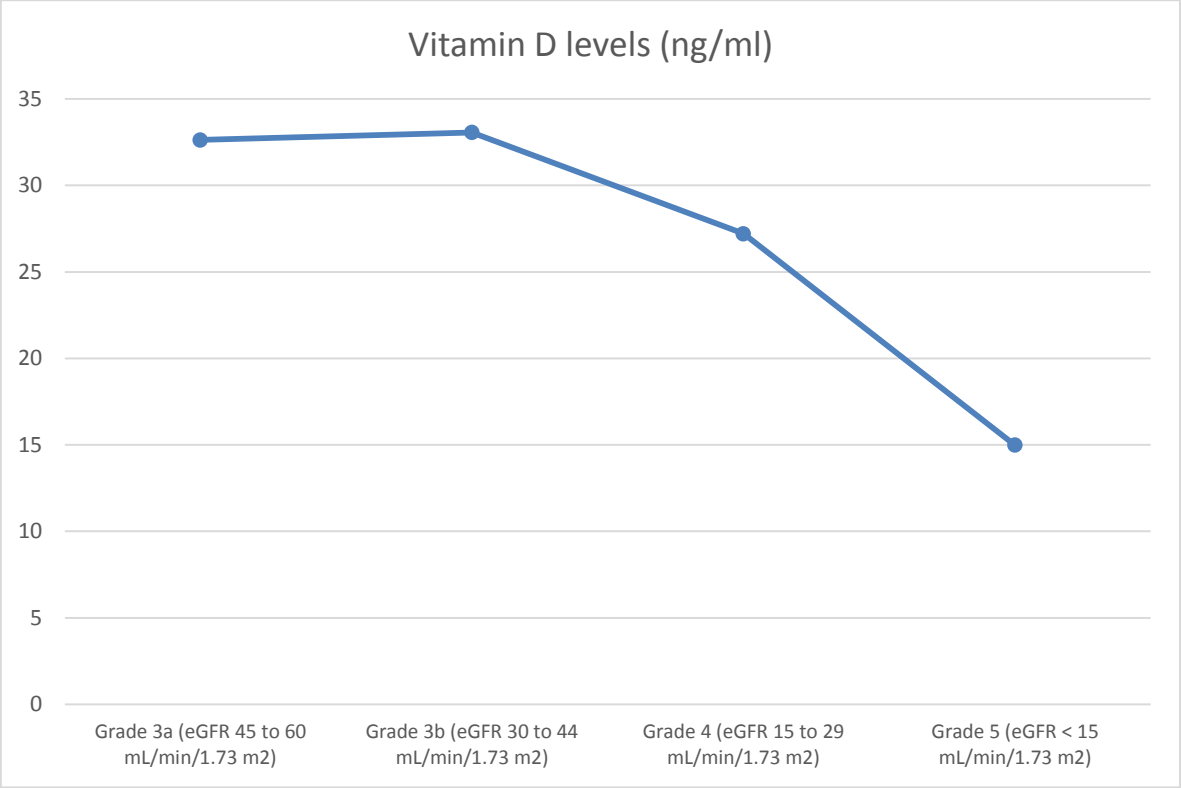
Table 1: Serum Vitamin D levels (ng/ml)

Serum Vitamin D levels (ng/ml)	Value
Mean	22.58
SD	16.00
Minimum	6.2
Maximum	56.5

Table 2: Distribution of patients according to Vitamin D levels

Serum Vitamin D levels (ng/ml)	Number of patients	Percentage
Sufficient (Serum Vitamin D levels between 30 to 100 ng/ml)	31	25.83
Insufficient (Serum Vitamin D levels between 10 to 29 ng/ml)	43	35.83
Deficient (Serum Vitamin D levels less than 10 ng/ml)	46	38.33
Total	120	100

Graph 1: Correlation of Vitamin D levels with CKD grading



Mean vitamin D levels among patients of CKD grade 3a, 3b, 4 and 5 was found to be 32.63 ng/ml, 33.06 ng/dl, 27.21 ng/dl and 14.9 ng/dl respectively. While comparing the vitamin D levels among patients with different severity grading of CKD, significant results were obtained.

Discussion

Vitamin D is regarded as pre-hormone obtained through the diet or via skin synthesis. Then it gone through subsequent activation in a sequential 2- step process, involving first 25-hydroxylation in the liver to produce 25-(OH) vitamin D and then 1- hydroxylation, which recently was thought to occur primarily in the kidney, to produce the active product 1,25 vitamin D or calcitriol. The 1,25 renal-activated end-product was responsible for all of the effects of the active vitamin D hormone in the body specially to regulate bone and mineral metabolism. A more expanded role for 25-(OH) vitamin D was suggested by the ubiquitous existence of the vitamin D receptor in the body, the presence of at least 800 human genes for which there is a vitamin D response element, and the wide distribution of the 1- alpha-hydroxylase in non-renal tissues such as the skin, vascular smooth muscle cells, pancreas, kidney, heart, immune system, intestine and sarcoid tissue. In India, there is a paradox that despite adequate sunlight, deficiency of vitamin D is quite prevalent in the general population. This may be explained by clothing habits of Indian population, their pigmented skin, and changing lifestyle with

limited outdoor activities. However, limited data are available in patients with CKD stage 5 on dialysis.[9-12]

In the present study, mean age of the patients was 54.7 years. In a study conducted by Biswas et al, mean age of the patients was 51.31 years.[13] In the present study, 60 percent and 52.94 percent of the patients of Grade 3a and 3b CKD were having sufficient vitamin D status while 28.57 percent and 5345 percent of the patients of Grade 4 and Grade 5 CKD were having deficient vitamin D status. Mean vitamin D levels among patients of CKD grade 3a, 3b, 4 and 5 was found to be 32.63 ng/ml, 33.06 ng/dl, 27.21 ng/dl and 14.9 ng/dl respectively. While correlation of Vitamin D levels and status with CKD grading analyzing statistically, significant results were obtained. Our results were in concordance with the results obtained by previous authors who also reported similar findings. In a previous study conducted by Satirapoj B et al, authors reported that significant differences were observed in stratified patients with 25-hydroxyvitamin D ≤ 30 ng/mL according to the CKD stages (CKD stage 3a; 66.6%, CKD stage 3b; 70.9%, CKD stage 4; 74.6% and CKD stage 5; 84.7%, $p<0.001$).[14] A lot of hypothesis were postulated regarding Vitamin D deficiency in chronic kidney disease in recent years. Since our study shows that vitamin D deficiency is more prevalent in higher grades of chronic kidney disease, we can infer that 1α hydroxylase activity decreases as the CKD grade increases. But a recent study on haemodialysis patients showed that 1, 25 dihydroxy vitamin D level increased after supplementation with nutritional vitamin suggesting that even in end stage renal disease there is enough extra renal 1 α hydroxylase activity to influence serum level. As our study results indicated that level of vitamin D decrease as eGFR declines, therefore hypovitaminosis D may be a useful diagnostic tool for assessment of risk of CKD disease progression to dialysis and death.[15]

Our findings complement recent observations suggesting that vitamin D deficiency is strongly associated with greater stages of CKD among adult participants. Among 14,679 US adult participants in the Third National Health and Nutrition Examination Survey (NHANES III), mean serum 25-hydroxyvitamin D level was lower in patients with stage 4–5 CKD compared with those with normal kidney function (24.6 vs. 29.3 ng/mL, $P <0.001$). Similarly, another study measured serum 25-hydroxyvitamin D levels in patients with CKD. The overall mean serum level of 25-hydroxyvitamin D was 19 ±14 ng/mL and only 29% of the 65 patients with stage 3 CKD and only 17% of 113 patients with stage 4 CKD had vitamin D insufficiency and deficiency.[16, 17] In another previous study conducted by Ghosh SK et al, authors evaluated the vitamin D status of CKD patients The mean eGFR for the patients was 25.15. The mean eGFR in the control group was 87.22. The mean Vitamin D level across the cases was 22.57. The mean vitamin D level in the control group was 35.24. The mean Vit D among the cases was 25.66 in non-dialysis patients and 10.94 in dialysis patients. 38 of the cases had vitamin D deficiency (20), 44 had vitamin d insufficiency (>30), and 18 had normal vitamin d levels.

A statistically significant positive connection between vitamin D level and eGFR was discovered. In CKD patients compared to controls, vitamin D deficiency and insufficiency were both more prevalent. In severe CKD stages, vitamin-D insufficiency was more pronounced.[18]

Conclusion

Because of the high rates of hypovitaminosis D and renal disease progression of CKD to end stage was observed in our study populations, treatment with vitamin D is may halt the progression of the disease. So, we can conclude that vitamin D level can be used as predictor of diagnosing CKD disease process towards progression.

References

1. Chen TK, Knicely DH, Grams ME. Chronic Kidney Disease Diagnosis and Management: A Review. JAMA. 2019 Oct 1;322(13):1294-1304.
2. Varughese S, Abraham G. Chronic Kidney Disease in India: A Clarion Call for Change. Clin J Am Soc Nephrol. 2018 May 7;13(5):802-804.
3. Snyder S, Pendergraph B. Detection and evaluation of chronic kidney disease. Am Fam Physician. 2005;72:1723–32.
4. Rajapurkar MM, John GT, Kirpalani AL, Abraham G, Agarwal SK, Almeida AF, et al. What do we know about chronic kidney disease in India: First report of the Indian CKD registry. BMC Nephrol. 2012;13:10.
5. Bhadoria AS, Kasar PK, Toppo NA, Bhadoria P, Pradhan S, Kabirpanthi V. Prevalence of hypertension and associated cardiovascular risk factors in Central India. J Family Community Med. 2014;21:29–38.
6. Webster AC, Nagler EV, Morton RL, Masson P. Chronic Kidney Disease. Lancet. 2017 Mar 25;389(10075):1238-1252.
7. Moe SM, Drueke T. Improving global outcomes in mineral and bone disorders. Clinical Journal of the American Society of Nephrology 2008; 3(Suppl. 3): S127–S130.
8. Slatopolsky E, Brown A, Dusso A. Role of phosphorus in the pathogenesis of secondary hyperparathyroidism. The American Journal of Kidney Diseases 2001; 37: S54–S57.
9. Williams S, Malatesta K, Norris K. Vitamin D and chronic kidney disease. Ethn Dis. 2009 Autumn;19(4 Suppl 5):S5-8-11.
10. Blair D, Byham-Gray L, Lewis E, McCaffrey S. Prevalence of vitamin D [25(OH)D] deficiency and effects of supplementation with ergocalciferol (vitamin D2) in stage 5 chronic kidney disease patients. J Ren Nutr. 2008;18:375–382.
11. Anderson S, Rennke HG, Brenner BM. Antihypertensive therapy must control glomerular hypertension to limit glomerular injury. J Hypertens Suppl. 1986 Dec;4(5):S242-4.

12. Yu HT. Progression of chronic renal failure. Arch Intern Med. 2003 Jun 23;163(12):1417-29.
13. Biswas S, Dey SK. Evaluation of Vitamin-D Level as an Important Diagnostic Predictor in Progression of Chronic Kidney Disease in Tertiary Care Hospital – A Prevalence Study. Journal of medical science and clinical research. 2018; 5(6): 106-113
14. Satirapoj B, Limwannata P, Chaiprasert A, Supasyndh O, Choovichian P. Vitamin D insufficiency and deficiency with stages of chronic kidney disease in an Asian population. BMC nephrology. 2013 Dec;14(1):1-5.
15. Melamed ML, Thadhani RI. Vitamin D Therapy in Chronic Kidney Disease and End Stage Renal Disease. Clin J Am Soc Nephrol.2012 Feb; 7(2): 358-365.
16. Chonchol M, Scragg R: 25-Hydroxyvitamin D, insulin resistance, and kidney function in the Third National Health and Nutrition Examination Survey. Kidney Int 2007, 71:134–139.
17. LaClair RE, Hellman RN, Karp SL, Kraus M, Ofner S, Li Q, Graves KL, Moe SM. Prevalence of calcidiol deficiency in CKD: a cross-sectional study across latitudes in the United States. American Journal of Kidney Diseases. 2005 Jun 1;45(6):1026-33.
18. Ghosh SK, Ghosh S. Cross-sectional Study on Vitamin D Status in CKD Patients. The Journal of the Association of Physicians of India. 2020 Apr 1;68(4):26-8.