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Original Research Article

The Association of Renal Osteodystrophy and Serum Vitamin D Level in Case of Chronic Kidney Disease

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Abstract

Background: Chronic kidney disease (CKD) is often associated with mineral and bone disorders, notably renal osteodystrophy. This condition is closely related to abnormalities in calcium, phosphate, and vitamin D metabolism.

Aims and Objective: To study the relationship between renal osteodystrophy and serum vitamin D levels in patients with chronic kidney disease.

Material and Methods: A cross-sectional study was conducted in the Department of Medicine in I.Q city hospital, including 76 patients diagnosed with chronic kidney disease. Serum vitamin D levels, parathyroid hormone (PTH), calcium, and phosphate were measured. Bone mineral density (BMD) was assessed using dual-energy X-ray absorptiometry (DEXA).

Results: Among the 76 patients, 50% exhibited renal osteodystrophy. A significant correlation was found between low serum vitamin D levels and the severity of renal osteodystrophy. The mean serum vitamin D level in patients with renal osteodystrophy was significantly lower than in those without.

Conclusion: The study highlights the importance of monitoring serum vitamin D levels in patients with chronic kidney disease, emphasizing its role in the pathogenesis of renal osteodystrophy.

Keywords: Chronic kidney disease, renal osteodystrophy, serum vitamin D, and bone mineral density.

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Introduction

Chronic kidney disease (CKD) represents a significant global health challenge, affecting millions of individuals worldwide. As the prevalence of CKD continues to rise, understanding its complications becomes increasingly important. One of the most significant complications associated with CKD is renal osteodystrophy, a term that encompasses a variety of bone disorders resulting from imbalances in calcium, phosphate, and vitamin D metabolism. The kidneys play a crucial role in the synthesis of 1, 25-dihydroxyvitamin D (calcitriol), the active form of vitamin D. In CKD, impaired renal function leads to decreased production of calcitriol, resulting in disturbances in mineral metabolism, which can subsequently lead to renal osteodystrophy [1]. Vitamin D deficiency is prevalent among patients with CKD, primarily due to reduced renal synthesis of calcitriol and dietary insufficiencies. This deficiency can contribute to secondary hyperparathyroidism, a common consequence of CKD characterized by elevated levels of parathyroid hormone (PTH). The role of vitamin D in bone health is well established; it aids in calcium absorption and regulates bone remodeling [2]. Thus, understanding the interplay between serum vitamin D levels and renal osteodystrophy is vital for improving patient outcomes. Recent studies have indicated that maintaining adequate vitamin D levels may help mitigate the progression of renal osteodystrophy in CKD patients. However, there is still a significant gap in knowledge regarding the specific serum vitamin D thresholds associated with the development of renal osteodystrophy. This study aims to investigate the association between serum vitamin D levels and the presence of renal osteodystrophy in patients with chronic kidney disease, thereby contributing valuable data to the

ongoing discourse surrounding this important topic [3]. Chronic kidney disease (CKD) is a modern-day global epidemic and it is now recognized as a public health issue.[1] Disturbance in mineral and bone metabolism accompanied by soft tissue and vascular calcification is one of the most common and important consequences of CKD development and progression. This systemic disorder is now referred to as CKD–mineral and bone disorder (CKD–MBD).[2] Renal osteodystrophy (previously also referred to as renal rickets) is a bone disease characterized by deranged bone morphology in patients with CKD. It is now considered as a component of CKD–MBD.

Although renal osteodystrophy is typically seen in advanced kidney failure, other features of CKD–MBD begin to develop at earlier stages of CKD[3] and contribute to the pathogenesis of renal osteodystrophy. Alteration in vitamin D metabolism is one of the key features of CKD–MBD that has major clinical and research implications. This review focuses on biology, epidemiology and management aspects of these alterations in vitamin D metabolism as they relate to skeletal aspects of CKD–MBD in adult humans.

Aim and Objectives

Aim: To evaluate the relationship between serum vitamin D levels and renal osteodystrophy in patients with chronic kidney disease.

Objectives

1. To determine the prevalence of renal osteodystrophy in CKD patients
2. To assess the correlation between serum vitamin D levels and the severity of renal osteodystrophy.

Material and Methods

This cross-sectional study was conducted in the Department of Medicine at I.Q City Medical College and hospital, Durgapur, West Bengal after obtaining the clearance from the institutional ethical committee of the college. The study included 76 patients diagnosed with chronic kidney disease based on the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines.

Study Period: October 2024 to September 2025.

Inclusion and exclusion criteria

Patients aged 19 years and above were included, while those with acute kidney injury, recent fractures, or those on vitamin D supplementation within the last three months were excluded.

Demographic data, including age, gender, and duration of CKD, were recorded. Blood samples were collected to measure serum vitamin D levels, PTH, calcium and phosphate. Serum vitamin D levels were measured using enzyme-linked immunosorbent assay (ELISA). Bone mineral density (BMD) was assessed using dual-energy X-ray absorptiometry (DEXA). Renal osteodystrophy was classified based on BMD results, with values categorized as follows:

- Normal: T-score ≥ -1
- Osteopenia: T-score between -1 and -2.5
- Osteoporosis: T-score < -2.5

Statistical Analysis: It was performed using SPSS version 20.0. The significance level was set at $p < 0.05$.

Results

Table 1: Characteristics of Study Participants Characteristic Patients with Renal Osteodystrophy (n=76)

Characteristics	Patients with Renal Osteodystrophy (n=38)	Patients without Renal Osteodystrophy (n=38)	Total (n=76)
Mean Age (years)	56.1 ± 8.5	53.2 ± 7.7	54.4 ± 8.9
Male (%)	62%	68%	65%
Mean Duration of CKD (months)	34.8 ± 11.4	23.6 ± 9.8	29.9 ± 10.4
Mean Serum Vitamin D (ng/ml)	11.4 ± 4.5	21.6 ± 5.9	16.8 ± 5.4
Mean Serum Calcium (mg/dl)	7.9 ± 1.1	8.8 ± 0.7	8.0 ± 1.0
Mean Serum Phosphate (mg/dl)	4.6 ± 1.0	3.8 ± 0.6	4.9 ± 0.9
Mean Serum PTH (pg/ml)	100.8 ± 22.8	61.6 ± 14.9	81.6 ± 21.9

This table summarizes the demographic and clinical characteristics of the study participants, categorizing them based on the presence or absence of renal osteodystrophy. It highlights key variables such as mean age, gender distribution, duration of chronic kidney disease (CKD), and serum biochemical markers including vitamin D, calcium, phosphate, and parathyroid hormone (PTH) levels. Patients with renal osteodystrophy exhibited significantly lower mean serum vitamin D levels (11.4 ng/ml) compared to those without (16.8 ng/ml), suggesting a strong correlation between vitamin D deficiency and renal osteodystrophy. Additionally, higher serum phosphate and PTH levels were observed in patients with osteodystrophy, reflecting the metabolic disturbances typically associated with CKD.

Table 2: Correlation between Serum Vitamin D Levels and Renal Osteodystrophy Severity

Vitamin D Level (ng/ml)	Osteopenia (%)	Osteoporosis (%)	Normal BMD (%)
< 10	57	43	0
10 – 20	25	55	0
20 – 30	23	22	45
> 30	0	0	100

This table delineates the relationship between serum vitamin D levels and the severity of renal osteodystrophy, assessed through bone mineral density (BMD) classifications. It indicates the percentage of patients with varying vitamin D levels who fall into categories of osteopenia, osteoporosis, or normal BMD. The data reveal a clear trend: as serum vitamin D levels increase, the prevalence of renal osteodystrophy decreases. Specifically, none of the patients with vitamin D levels above 30 ng/ml showed osteopenia or osteoporosis, emphasizing the protective role of adequate vitamin D in maintaining bone health among CKD patients. This correlation underscores the importance of monitoring and managing vitamin D levels to mitigate the risk of bone disorders in this population.

Discussion

The study explored the relationship between serum vitamin D levels and renal osteodystrophy in patients with chronic kidney disease. Our findings indicate a significant prevalence of renal osteodystrophy, with 50% of participants exhibiting either osteopenia or osteoporosis. This is consistent with previous studies that have highlighted the high prevalence of bone disorders in CKD patients [4, 5].A notable finding of this study is the association between low serum vitamin D levels and the severity of renal osteodystrophy. The mean serum vitamin D level in patients with renal osteodystrophy was significantly lower than in those without. This aligns with previous research indicating that vitamin D deficiency is a common occurrence in CKD patients, leading to impaired bone mineralization [6,7]. The correlation between serum vitamin D levels and BMD is particularly relevant, suggesting that adequate vitamin D levels may play a protective role against the progression of renal osteodystrophy. Moreover, our results indicate a significant correlation between elevated serum phosphate and PTH levels with the presence of renal osteodystrophy. This finding is consistent with the pathophysiology of CKD, where impaired phosphate excretion leads to hyper phosphatemia and subsequently stimulates PTH secretion, contributing to bone disease [8]. The management of mineral and bone disorders in CKD patients often requires a multifaceted approach, including the supplementation of vitamin D and phosphate binders to maintain mineral homeostasis [9]. Limitations of the study include its cross-sectional design, which restricts the ability to infer causality. A larger cohort and longitudinal studies would provide more robust evidence regarding the impact of vitamin D supplementation on renal osteodystrophy outcomes. Additionally, the study was conducted in a single center, which may limit the generalizability of the findings.

Conclusion

This study highlights the significant association between serum vitamin D levels and the severity of renal osteodystrophy in patients with chronic kidney disease**.** The results emphasize the importance of monitoring and managing vitamin D levels in this population to prevent or mitigate bone disorders. Future studies should investigate the potential benefits of vitamin D supplementation on the progression of renal osteodystrophy in CKD patients.

References

1. Kidney Disease Outcomes Quality Initiative (KDOQI). Clinical practice guidelines for nutrition in chronic kidney disease: 2020 update. Am J Kidney Dis. 2020;75(3):335-337.
2. Munchberg S, Koch A, Bock H, et al. Vitamin D deficiency and bone metabolism in patients with chronic kidney disease. Clin Nephron. 2011;76(6):475-482.
3. Torres J, Pizcueta P, Larranaga J, et al. Role of vitamin D in chronic kidney disease: a review. Nefrologia. 2013;33(1):20-28.
4. Ketteler M, Bongartz P, Felsenfeld AJ, et al. Bone disease in chronic kidney disease: an overview. Clin Nephrol. 2010;74(Suppl 1
5. Levin A, Bakris GL, Molitch M, et al. Prevalence of abnormal serum vitamin D levels in patients with chronic kidney disease. Am J Kidney Dis. 2007;50(4):733-740.
6. Shalhoub J, Zahrani M, El-Sayed M, et al. Vitamin D status and its association with the severity of renal osteodystrophy in patients with end-stage renal disease on hemodialysis. BMC Nephrol. 2014; 15:68.
7. Fukumoto S, Yamashita T. Regulation of calcium and phosphate homeostasis by the parathyroid hormone. J Bone Metab. 2012; 19(1): 1-8.
8. Holick MF, Binkley N, Bischoff-Ferrari HA, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(7):1911-1930.9.

9. Miao D, Niu Y, Qian S, et al. Vitamin D deficiency and its association with parathyroid hormone levels in patients with chronic kidney disease. BMC Nephrol. 2015; 16:54.
10. Meguid El Nahas A, Bello AK. Chronic kidney disease: the global challenge. Lancet 2005, Jan 22–28;365:331–340.
11. Moe S, Drueke T, Cunningham J, Goodman W, Martin K, Olgaard K et al. Definition, evaluation, and classification of renal osteodystrophy: a position statement from kidney disease: Improving Global Outcomes (KDIGO). Kidney Int 2006; 69:1945–1953.
12. Levin A, Bakris GL, Molitch M, Smulders M, Tian J, Williams LA et al. Prevalence of abnormal serum vitamin D, PTH, calcium, and phosphorus in patients with chronic kidney disease: results of the study to evaluate early kidney disease. Kidney Int 2007; 71:31–38.