Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 11, 2024

Assessing Serum Vitamin D Levels in Hypertension and Related Complications

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Conflict of interest: No! Conflict of interest is found elsewhere considering this work.
Source of Funding: There was no financial support concerning this work

Abstract

Background: Vitamin D deficiency is associated with hypertension and its complications, including retinopathy, chronic renal failure (CRF), and left ventricular hypertrophy (LVH). Its role in vascular health and blood pressure regulation makes it a critical factor in managing hypertensive damage.

Objectives: To estimate serum Vitamin D levels in patients with hypertension and assess its relationship with complications such as retinopathy, CRF, and LVH.

Material and Methods: A cross-sectional study of 80 hypertensive patients categorized Vitamin D levels into <10 ng/dl, 10-20 ng/dl, 20-30 ng/dl, and >30 ng/dl. Complications were assessed using fundus examination, eGFR, and electrocardiography.

Results: Vitamin D deficiency (10-20 ng/dl) was prevalent in 45% of patients, with severe deficiency (<10 ng/dl) more common in those with CRF (25.8%) and LVH (15.4%). Sufficient Vitamin D levels (>30 ng/dl) were associated with fewer complications.

Conclusion: Vitamin D deficiency significantly correlates with hypertension-related complications. Monitoring and correcting Vitamin D levels may help reduce these risks and improve patient outcomes.

Keywords: Cardiovascular health, Cross-Sectional, Hypertension, Vitamin D

Introduction

Hypertension is a widespread condition that contributes to the development of serious complications such as cardiovascular disease, stroke, and kidney failure. The relationship between Vitamin D deficiency and hypertension has gained attention in recent years due to evidence suggesting that inadequate levels of Vitamin D may influence blood pressure regulation. Vitamin D participates in a range of processes that affect vascular health, including modulation of the renin-angiotensin system, which plays a crucial role in regulating blood pressure. Low levels of Vitamin D may lead to increased blood pressure by affecting smooth muscle function, vascular tone, and inflammatory pathways that engage in hypertension [1, 2, 3].

Moreover, Vitamin D deficiency has been linked to the exacerbation of hypertension-related complications. Studies suggest that low Vitamin D levels can worsen outcomes in patients with hypertension by contributing to atherosclerosis, kidney dysfunction, and other cardiovascular risks. Vitamin D's role in reducing inflammation and improving endothelial function may be important in preventing the damage caused by chronic hypertension [4, 5, 6].

Given the growing interest in the potential therapeutic benefits of Vitamin D in hypertension management, assessing serum Vitamin D levels in hypertensive individuals may provide valuable insights. It could reveal whether Vitamin D deficiency is more prevalent in patients with hypertension and its complications, and whether correcting these deficiencies could improve blood pressure control and reduce complications. While further research is needed to confirm these

relationships, understanding the link between Vitamin D levels and hypertension may open new avenues for prevention and treatment strategies [5, 7, 8].

The aims of the present study are to estimate serum Vitamin D levels in essential hypertension and hypertension-related complications, and to establish the relationship between serum Vitamin D levels and hypertension and its related complications.

Material and Methods

The study involves 80 patients attending the Tertiary care center OPD, screened for hypertension and related complications. Based on inclusion and exclusion criteria, eligible patients are enrolled. Male and female patients above 18 years with hypertensive retinopathy, hypertensive renal disease, or hypertensive cardiac disease are included. Hypertensive retinopathy is assessed through fundus examination using a Direct Ophthalmoscope, categorizing findings from mild narrowing to papillary edema. For hypertensive renal disease, eGFR is calculated using serum creatinine and age, and for hypertensive cardiac disease, ECG findings suggestive of left ventricular hypertrophy are considered.

Exclusion criteria include patients with diabetes mellitus (HBA1C > 7%), thyroid dysfunction (abnormal T3, T4, TSH levels), those on Vitamin D or other nutritional supplements, and patients with a history of gastrointestinal surgeries.

The 80 patients are divided into subgroups based on their serum Vitamin D levels: normal (>30 ng/dl), insufficiency (20-30 ng/dl), and deficiency (<20 ng/dl). They are then screened for hypertension-related complications such as hypertensive retinopathy, kidney disease, and cardiac disease. Statistical analysis is used to explore the relationship between serum Vitamin D levels and these complications.

Results

Based on the observational study conducted the following results have been obtained and analyzed statistically.

Figure 1 represents the distribution of 80 patients by age group and gender in a study on hypertension and related complications. The age groups are divided into seven categories ranging from 26-30 years to 56-60 years. Each column is split into two sections: one for male patients and one for female patients. The chart highlights the larger proportion of male participants across most age groups, with the highest number of participants (both male and female) in the 36-40 and 41-45 age groups. It provides a clear visual of the demographic breakdown of the study sample.

Table 2 presents the distribution of serum Vitamin D levels among 80 cases. Most cases (45%) are in the 11-20 ng/dl range, indicating a significant prevalence of Vitamin D deficiency. Approximately 20% fall within the 21-30 ng/dl range, reflecting insufficiency, while 23.75% have normal levels (>30 ng/dl). A smaller proportion, 11.25%, shows severe deficiency (<10 ng/dl). This data highlights the widespread occurrence of Vitamin D insufficiency and deficiency in the studied population.

Figure 2 illustrates the distribution of serum Vitamin D levels among 80 patients, divided into those with and without retinopathy. Most retinopathy patients fall into the 10-20 ng/dl range, indicating significant Vitamin D deficiency in this group. Patients without retinopathy are more evenly distributed, with a notable proportion having Vitamin D levels >30 ng/dl. Severe deficiency (<10 ng/dl) is more common in retinopathy patients, suggesting a potential link between low Vitamin D levels and retinopathy.

Figure 3 illustrates the distribution of serum Vitamin D levels among 80 patients, divided into those with and without chronic renal failure (CRF). The majority of CRF patients fall in the 10-20 ng/dl range, indicating significant Vitamin D deficiency, while patients without CRF are more

evenly distributed, with a notable proportion having Vitamin D levels >30 ng/dl. Severe deficiency (<10 ng/dl) is observed in CRF patients, suggesting a strong association between low Vitamin D levels and the presence of CRF.

Figure 4 illustrates the distribution of serum Vitamin D levels among 80 patients, categorized into those with and without left ventricular hypertrophy (LVH). The majority of LVH patients have Vitamin D levels in the 10-20 ng/dl range, indicating significant deficiency. In contrast, a notable portion of patients without LVH fall into the >30 ng/dl category, reflecting sufficient Vitamin D levels. Severe deficiency (<10 ng/dl) is slightly more prevalent in patients with LVH, highlighting a potential link between low Vitamin D levels and LVH.

Figure 1: Distribution of study population according to their age groups

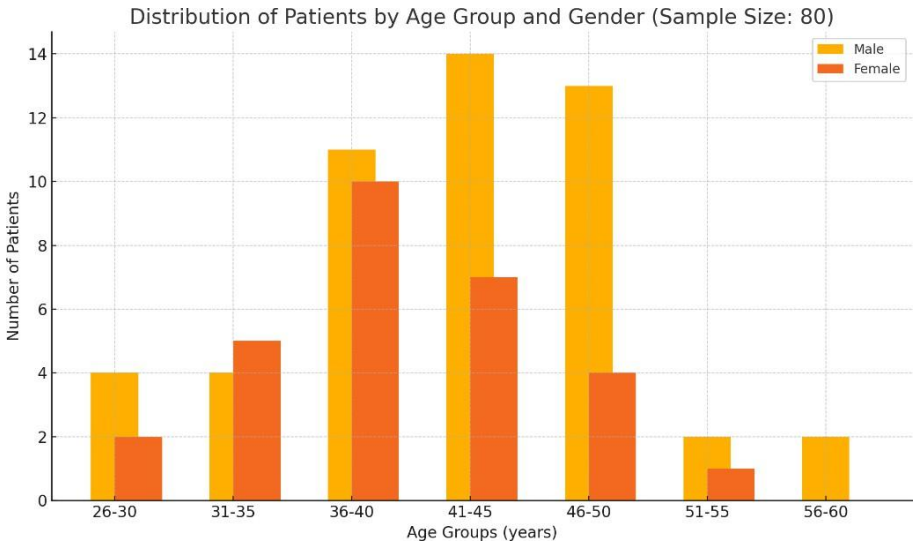


Table 1: Distribution of study population according to serum Vitamin D levels

Serum Vitamin D	**Number of Cases**	**Percentage**
<10 ng/dl	9	11.25%
11-20 ng/dl	36	45.00%

21-30 ng/dl	16	20.00%
>30 ng/dl	19	23.75%

Figure 2: Frequency distribution of serum vitamin D level in Retinopathy patients

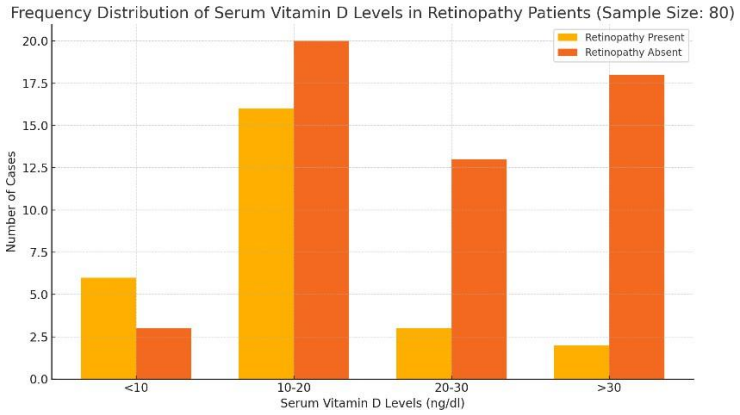


Figure 3: Frequency distribution of serum vitamin D levels in CRF patients

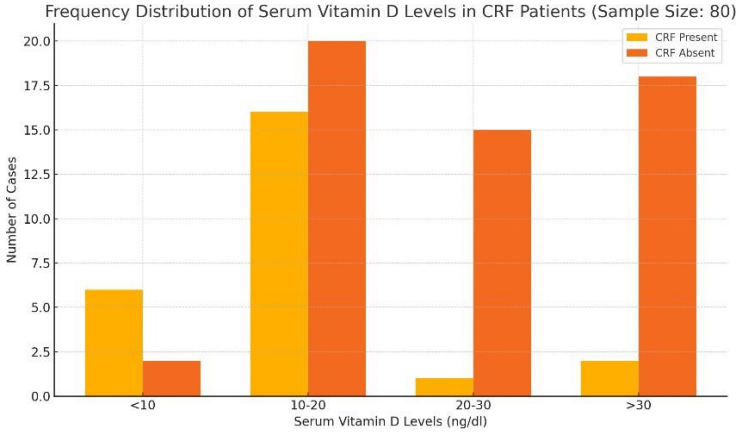
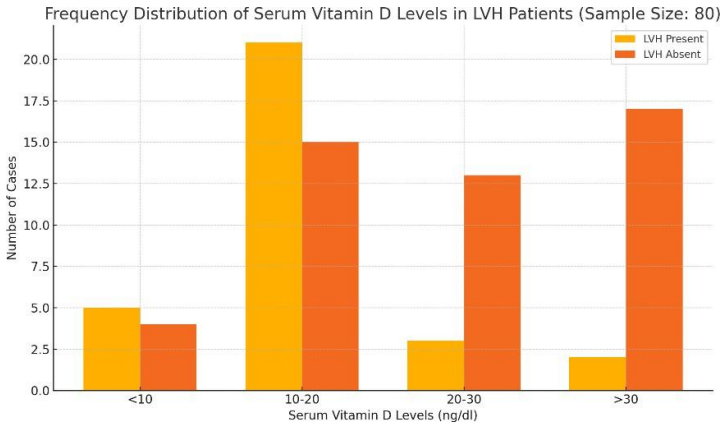


Figure 4: Frequency distribution of serum vitamin D levels in LVH patients



Discussion

The findings demonstrate significant associations between serum Vitamin D levels and hypertension-related complications such as retinopathy, chronic renal failure (CRF), and left ventricular hypertrophy (LVH). A considerable proportion of patients with these complications had Vitamin D deficiency (10-20 ng/dl), underscoring its potential role in exacerbating disease outcomes.

Vitamin D deficiency was more pronounced among patients with LVH and CRF, as lower levels are associated with increased RAAS activity and myocardial remodeling, contributing to LVH development [4, 5, 6]. Similarly, severe deficiency (<10 ng/dl) was higher among retinopathy patients, linked to vascular dysfunction caused by insufficient Vitamin D [3, 6].

Patients without complications displayed a more even distribution of Vitamin D levels, with higher proportions in the sufficient range (>30 ng/dl). This suggests that adequate Vitamin D levels may exert protective effects by improving vascular tone, reducing inflammation, and mitigating hypertensive damage [2, 7].

These findings highlight the need for routine Vitamin D monitoring and correction in hypertensive patients, particularly those at risk for complications. Further studies should evaluate the long-term

benefits of Vitamin D supplementation in reducing the burden of hypertension-related complications.

Conclusion

This study highlights the significant association between serum Vitamin D levels and hypertension-related complications such as retinopathy, chronic renal failure, and left ventricular hypertrophy. Vitamin D deficiency, particularly in the 10-20 ng/dl range, was prevalent among patients with these complications, underscoring its potential role in disease progression. Adequate Vitamin D levels (>30 ng/dl) offered protective effects, emphasizing the importance of maintaining sufficient levels. These findings suggest that routine assessment and management of Vitamin D deficiency may serve as an effective strategy to reduce the burden of hypertension-related complications. Further research is needed to evaluate the long-term benefits of Vitamin D supplementation in hypertensive populations.

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