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Serum Vitamin D in Chronic Periodontitis

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Abstract: Background Vitamin D is a lipid soluble vitamin also called as sunshine vitamin as it is synthesized in skin by exposure to ultraviolet rays. It is mainly required for bone growth, calcium metabolism, cellular growth and differentiation, immunity and cardiovascular function. In periodontitis systemic release of proinflmmatory cytokines occurs at accelerated rate resulting in enhanced systemic bone resorption.
Keywords: Vitamin D, chronic periodontitis, infections, VDR

I. AIMS & OBJECTIVES

To study serum vitamin D levels in chronic periodontitis and to compare them with age and sex matched healthy controls.

II. MATERIALS AND METHODS

The present study was conducted in the Department of Biochemistry in collaboration with Department of Periodontics, Pt. B.D. Sharma, PGIMS, Rohtak. Thirty chronic periodontitis patients were recruited in study group (Group II) after confirmed diagnosis and 30 age and sex matched healthy controls were included in group I (Control group). Patients on drugs altering vitamin D levels like antiepileptic drugs, vitamin D intake, suffering from any chronic disease (renal, hepatic disease, endocrine, malignancy) that could affect study participation or confound data interpretation and those with other risk factors of hypovitaminosis like gastric or bowel resection, malabsorption were excluded from the study. Study samples were drawn and serum vitamin D levels were analyzed by radioimmunoassay.

III. RESULTS

Mean serum vitamin D levels were significantly decreased in group II (26.04$\pm$11.58 ng/mL) as compared to group I (35.43$\pm$12.35 ng/mL; p=0.004). 6.67% patients of group I and 20% of group II had deficient levels of vitamin D; 26.67% of group I and 40% of group II had insufficient levels of vitamin D, and only 66.67% of group I and 40% of group II had sufficient levels of vitamin D.

IV. CONCLUSION

The 1, 25(OH) $_2$ D3-VDR system plays a significant role in oral homeostasis and its dysfunction leads to periodontal disease. Hence, Vitamin D research should make important contributions to the understanding of periodontal diseases and may benefit in the treatment due to its direct effect on bone metabolism and its anti-inflammatory properties.

V. INTRODUCTION

Vitamin D is a lipid soluble vitamin, synthesized endogenously by stimulation of skin through ultraviolet rays, hence also called as sunshine vitamin. It is mainly required for bone growth, calcium and phosphate metabolism, cellular growth and differentiation, immunity and cardiovascular function.[1,2] Vitamin D regulates calcium and phosphate homeostasis, through its action on the expression of vitamin D receptor (VDR) on at least three organs, the kidney, the small intestine and the bone tissue.[3] It stimulates intestinal absorption, bone resorption and renal reabsorption.[4] Several VDR restriction fragment length polymorphism (RFLPs) has been reported with many diseases such as secondary hyperparathyroidism in the renal failure, osteoporosis, cancer, nephrolithiasis, diabetes and periodontal disease.[5]

Periodontitis is which is characterized by damage to the soft tissue and bone that surrounds the teeth. It can often result in gum recession and loosening of the teeth. It is the most common cause of tooth loss in the elderly. The pathogenesis of periodontitis is based on bacterial driven inflammation. Therefore, vitamin D has been hypothesized to decrease the risk of periodontitis by maintaining oral health by exerting its anti-inflammatory effects and reducing pathogenic bacteria.[6]

Vitamin D deficient individuals are more prone to low mineral bone density/osteoporosis, osteopenia, infectious and chronic inflammatory diseases. Through its effect on bone and mineral metabolism, innate immunity, and several VDR gene polymorphisms, vitamin D has been reported to be associated with the periodontal disease.[7] Osteoporosis results in decreased bone

mineral density throughout the body, including maxilla and the mandible. The lowered density of jaw bones leads to increased alveolar porosity, an altered trabecular pattern and more rapid alveolar bone resorption following invasion by periodontal pathogens. Periodontal infections increases the systemic release of proinflammatory cytokines, which accelerates systemic bone resorption.[8]

Vitamin D also acts as an anti-inflammatory agent because it inhibits immune cell cytokine expression and causes monocyte/macrophages to secrete molecules that have a strong antibiotic effect. Vitamin D exert an indirect antimicrobial and anti-inflammatory effect so that pathologically low levels of Vitamin D may result in infection or immune dysfunction.[9] This suggests that vitamin D may be of benefit in the treatment of periodontitis, not only because of its direct effects on bone metabolism, but also because it may have antibiotic effects on periodontopathogens and inhibit inflammatory mediators that contribute to the periodontal destruction. Insufficient clearance of periodontopathic bacteria and subsequent bone destruction are suggested to cause aggressive periodontitis.[10] VDR ligands stimulate innate immunity by inducing antimicrobial peptides and have bone anabolic effects,[1,11] suggesting that VDR ligands can be applied for prevention of aggressive periodontitis. A dysregulated release of proinflammatory cytokines by monocytes/macrophages and lymphocytes is considered to induce chronic periodontitis.[10] Since 1,25 (OH)2 D3 has potent immunomodulatory effects, including inhibition of proinflammatory cytokines release.[1,12] VDR ligands may be effective in treatment of chronic periodontitis.

Host defense peptides, such as β-defensins and cathelicidins from oral epithelial cells provides protection against periodontal infections.[13] Cathelicidin has antimicrobial activity against gram-positive bacteria, gram negative bacteria and some viruses.[14] 1,25 (OH)2 D3 can induce the expression cathelicidin and increases its antibacterial activity against pathogenic bacteria, suggesting that vitamin D could have beneficial effect in periodontal health.[15] In the presence of pathogens, Toll-like receptors on human monocytes and macrophages activate gene of vitamin D pathways including the CYP27B1 gene and the VDR. The subsequent increased production of 1,25-α hydroxlase resulted in an increase .of the production of cathelicidin and enhanced antimicrobial effects.[16]

Hence the present study was planned to estimate the serum vitamin D levels in chronic periodontitis and to compare them with age and sex matched healthy controls.

VI. MATERIALS AND METHODS

The present study was conducted in the Department of Biochemistry in collaboration with Department of Periodontics, Pt. B.D. Sharma, PGIMS, Rohtak. Thirty chronic periodontitis patients were recruited in study group (Group II) after confirmed diagnosis and 30 age and sex matched healthy controls were included in group I (Control group). Patients on drugs altering vitamin D levels like antiepileptic drugs, vitamin D intake, suffering from any chronic disease (renal, hepatic disease, endocrine, malignancy) that could affect study participation or confound data interpretation and those with other risk factors of hypovitaminosis like gastric or bowel resection, malabsorption were excluded from the study.

Five milliliters of maternal venous blood sample was collected aseptically from anticubital vein. The serum was separated by centrifugation and analyzed the same day. Serum vitamin D levels were assessed by radioimmunoassay.

Vitamin D levels were stratified into: deficiency ($\leq$ 14 ng/mL), insufficiency (15-29 ng/mL) and sufficiency ($\geq$ 30ng/mL)

Result were expressed as mean values $\pm$ standard deviation and student's 't' test was applied. Data were considered to be significant if $p < 0.05$ and highly significant with $p<0.001$. SPSS, version 17.0 was used in the analysis (SPSS Inc. Released 2008. SPSS Statics for Windows, version 17.0. Chicago: SPSS Inc.).

VII. RESULTS

Table I: Serum vitamin D (ng/mL) levels in both groups (MEAN±SD)

	Group I	Group II
Mean $\pm$ SD	35.43$\pm$12.35	26.04$\pm$11.58*
Median	35.5	27.15
Range	13.08-63.72	4.90-49.08

* $p<0.01$ as compared to Group I

Mean serum vitamin D levels were significantly decreased in group II (26.04$\pm$11.58 ng/mL) as compared to group I (35.43$\pm$12.35 ng/mL; p=0.004)

Table II: Distribution of subjects according to serum vitamin D (ng/mL) levels

Vitamin D (ng/mL)	Group I	Group II
≤14 ng/mL	2 (6.67%)	6 (20%)
15-29 ng/mL	8 (26.67%)	12 (40%)
≥30 ng/mL	20 (66.675)	12 (40%)

As shown in the above table, 6.67% patients of group I and 20% of group II had deficient levels of vitamin D; 26.67% of group I and 40% of group II had insufficient levels of vitamin D, and only 66.67% of group I and 40% of group II had sufficient levels of vitamin D.

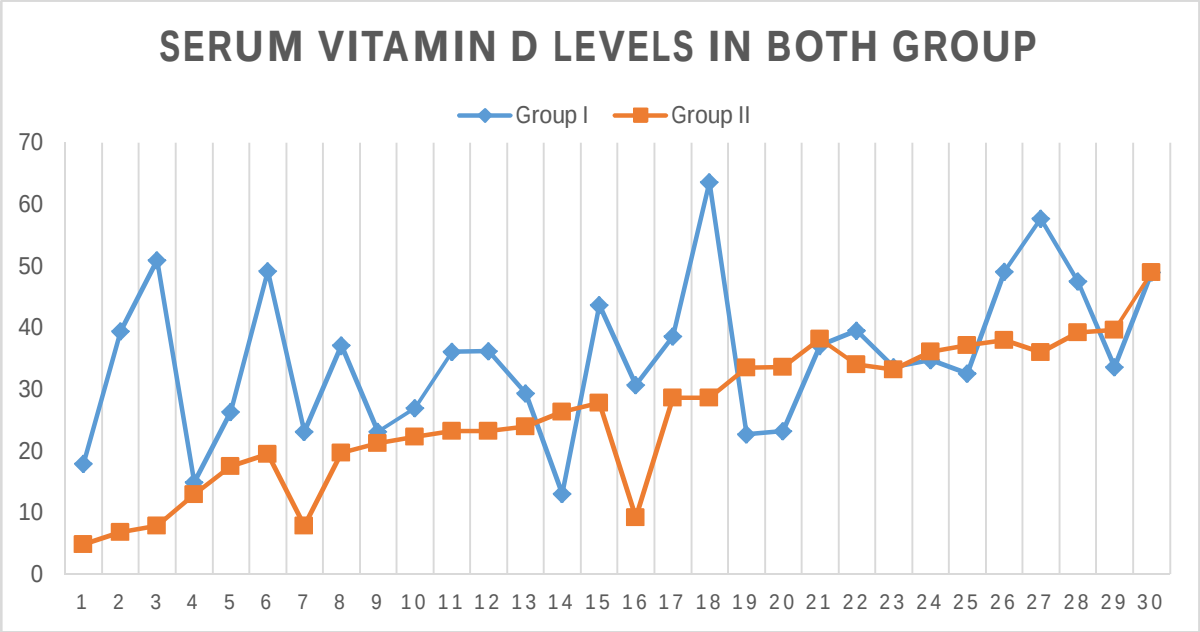

Figure I: Serum vitamin D (ng/mL) levels in both groups

VIII. DISCUSSION

In the present study mean serum vitamin D level in group I was 35.43±12.35 ng/ml (range 13.08 to 63.72 ng/ml). Out of 30 subjects in group I, 2 subjects had serum vitamin D levels ≤14 ng/ml, 8 subjects had 15 to 29 ng/ml, and 20 subjects had serum vitamin D levels ≥ 30 ng/ml. In group II, mean serum vitamin D level was 26.04±11.58 ng/ml (range 4.90 to 49.08 ng/ml). 6 patients had serum vitamin D levels ≤14 ng/ml, 12 patients had 15 to 29 ng/ml, and 12 patients had serum vitamin D levels ≥ 30 ng/ml.

Previous studies had reported an inverse relation between serum concentration of 25 (OD) D3 and prevalence of bleeding on probing (BOP) after correction for a number of confounding variables. This anti-inflammatory property of vitamin D is mainly responsible for this inverse relation and the higher serum 25 (OH)D levels may be beneficial in regards to gingival health.[19]

Researchers studied the association of serum vit D levels and chronic periodontitis in patients with chronic kidney disease (CKD). They reported that patients with CKD and chronic periodontits had decreased serum vitamin D levels and were most often insufficient/deficient in 25(OH) D in relation to CKD patients without chronic periodontitis.[20]

Jabbar et al compared postmenopausal women with and without periodontal disease and observed that the serum concentations of 25 (OH) D3 were significantly lower in those with either active or past periodontal disease. [21]

Recent studies showed that dietary supplementation with calcium and vitamin D may improve periodontal health, increase bone mineral density in the mandible and inhibit alveolar bone resorption.[17,18] After vitamin D supplementation with different dosage in different groups for a period of 3 months , a dose dependent gingival anti-inflmamatory effect of vitamin D was observed. Patients on 2000 IU of vitamin D showed reduction of gingivitis faster than the patients in the 500 IU group. At serum vitamin D concentration of above 30-35 ng/mL its anti-inflmaamtory action was seen.[22]

A prospective study showed a positive association between the serum 1,25(OH) D and periodontal helath in type I diabetic patients. More specifically , patients with no or mild chronic periodontitis at baseline had higher mean 1,25(OH) D levels compared to patients with moderate or severe chronic periodontitis. Periodontal therapy and elimination of inflammation resulted in an increase in serum 1,25 (OH) D levels with no conclusions drawn however for the possible underlying mechanism.[23]

In contrast, some authors reported no association between vitamin D and periodontal disease progression after adjusting for confounding factors including age, education, frequency of dental visits, smoking status, self reported history of diabetes, current use of osteoporosis related medications or bone therapies, BI, recreational physical activity and baseline measure of periodontal disease. They concluded that supplementation of vitamin D for prevention of periodontal disease progression is not needed at this time.[24]

Increased intake levels of calcium and vitamin D had a beneficial effcet on tooth retention. However, only total calcium supplementation and not vitamin D was inversely associated with risk for tooth loss. Moreover, tooth loss was self reported by the patients through questionnaries for the etiology of teeth loss.[25] Subjects enrolled in periodontal maintenance program who took oral vitamin D and calcium supplememtation presented a better trend of periodontal health as indicated by clinical and radiographic measurements, compared to those who did not.[26] Garcia et al. reported that calcium and vitamin D supplementation may reduce the severity of periodontal disease if used at doses higher than 800-1,000 IU daily and supported the rationale for testing the potential beneficial role of vitamin D on periodontal disease in randomized clinical trials.

IX. CONCLUSION

The findings of the present study confirm the association of vitamin D in chronic periodontitis. Vitamin D and its role in general health have recently attracted a considerable interest in both research and clinical care. The 1, 25(OH) $_2$ D3-VDR system plays a significant role in oral homeostasis and its dysfunction leads to periodontal disease. Hence, Vitamin D research should make important contributions to the understanding of periodontal diseases and may benefit in the treatment due to its direct effect on bone metabolism and its anti-inflammatory and immune properties.

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