

Correlation of Serum Vitamin D Level with Osteoarticular Infection

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Abstract

Introduction: Vitamin D regulates innate and adaptive immune function, including activation and differentiation of macrophages, dendritic cells and lymphocytes. The non-skeletal actions of vitamin D are mediated by the gene expression in a number of organs.

Aims and Objectives: To study correlation of serum vitamin D level with osteoarticular infection.

Materials and Methods: The study included 50 patients presented with osteoarticular infection, aseptic loosening and other bony pathology. Serum 25OHD level and other parameters were measured as per standard protocol.

Results: The mean age of participants was 37.94 ± 12.71 . The mean S. Vitamin D (ng/mL) was 19.01 ± 8.04 . There was no significant difference between the groups in terms of S. Vitamin D (ng/mL) ($F = 1.620$, $p = 0.198$).

Conclusion: Patients with osteoarticular infection had vitamin D deficiency. However, statistically significant correlation between lower level of serum vitamin D level in comparison to non-infectious disease was not found.

Keywords: Dendritic Cells, Osteoarticular Infection, Innate And Adaptive Immunity.

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Introduction

Classical actions of vitamin D, such as promotion of calcium homeostasis and bone health are well known, and several studies suggest that it also regulates innate and adaptive immune function, including activation and differentiation of macrophages, dendritic cells and lymphocyte

[1]. The three main phases in vitamin D metabolism, 25-hydroxylation, 1 alfa-hydroxylation, and 24-hydroxylation, are all phases done by cytochrome P450 oxidases. In the first phase, vitamin D converts into 25 hydroxy-vitamin D [2].

These non-skeletal actions of vitamin D are cellular proliferation, angiogenesis, differentiation and apoptosis. In these contexts, mechanism of action of vitamin D is similar to the way steroid hormones act, so vitamin D is considered more a hormone than a vitamin. 1,25 dihydroxy-vitamin D has been reported in animal models and in cultured cells to improve insulin production, modulate T- and B-cell activity, enhance phagocytic activity [3].

There is many other roles of vitamin D found in human body other than its classical actions on calcium metabolism and musculoskeletal system health. Most of the body tissues have receptors for, 1,25 dihydroxy-vitamin D, which act as an active form of vitamin D and they are known as vitamin D receptors [4].

Vitamin D could stimulate immunity, mostly innate immunity. This observation comes from study about tuberculosis treatment with cod liver oil. It activates the transcription of antimicrobial peptides, such as defensin B and cathelicidin and enhances chemotaxis and phagocytic activity of innate immune cells [5]. In particular, dendritic cells are antigen-presenting cells that play an important role in maintaining tolerance.

This study was undertaken to find the correlation of serum vitamin D level with osteoarticular infection in Indian population.

Aims and Objectives

To evaluate serum vitamin D level in osteoarticular infection and to study correlation between them.

Materials and Methods

The study was carried out at Central Institute of Orthopaedics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi from November 2018 to March 2020 which included 50 patients presented with osteoarticular infection, aseptic loosening and other bony pathology.

Serum 25OHD level was measured of every patient presented with, osteoarticular infections or aseptic loosening or other osteoarticular pathologies. Prosthetic loosening was diagnosed on preoperative radiography and infection was diagnosed when the patient presented elevated erythrocyte sedimentation rate and C-reactive protein concentration, elevated synovial leukocyte count, presence of purulence in the affected part and isolation of a microorganism in intraoperative tissue cultures or prosthetic implants.

Patients were divided into four groups i.e. Group A (Patients with periprosthetic joint infection), Group B (Patients with aseptic loosening), Group C (Patients with septic arthritis, osteomyelitis and infected implant) and Group D (Other bony and ligament pathology).

Quantitative variables compared by using ANOVA between the four groups. Qualitative variables were compared by using Chi-Square test. A p value of <0.05 was considered statistically significant. All the statistical data were analyzed using (SPSS) version 21.

Results

This was an observational cross-sectional comparative study that was carried out at Central Institute of Orthopaedics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi for a period of 18 months.

15 (30.0%) of the participants had Group: A. 5 (10.0%) of the participants had Group: B. 20 (40.0%) of the participants had Group: C. 10 (20.0%) of the participants had Group: D. The mean Age (Years) was 37.94 ± 12.71 . 3 (6.0%) of the participants had Age: ≤ 20 Years. 16 (32.0%) of the participants had Age: 21- 30 Years. 9 (18.0%) of the participants had Age: 31-40 Years. 13 (26.0%) of the participants had Age: 41-50

Years. 8 (16.0%) of the participants had Age: 51-60 Years. 1 (2.0%) of the participants had Age: 61-70 Years. 42 (84.0%) of the participants had Gender Male and 8 (16.0%) of the participants had Gender: Female.

The mean S. Vitamin D (ng/mL) was 19.01 ± 8.04 . 33 (66.0%) of the participants had S. Vitamin D: Deficient. 13 (26.0%) of the participants had S. Vitamin D: Insufficient. 4 (8.0%) of the participants had S. Vitamin D: Sufficient. The mean ESR (mm/Hr) was 54.56 ± 30.82 . The mean CRP was 2.50 ± 1.74 . The mean S. Calcium (mg/dL) was 8.27 ± 1.60 . The mean S. Albumin (g/dL) was 3.67 ± 0.72 . The mean Bone specific ALP was 119.38 ± 56.14 . The mean Hemoglobin (g/dL) was 11.14 ± 2.07 . The mean TLC (/cu.mm) was 12316.00 ± 4642.10 .

The mean (SD) of S. Vitamin D (ng/mL) was 19.01 (8.04). The median (IQR) of S. Vitamin D (ng/mL) was 18.20 (13.67-22.4). The S. Vitamin D (ng/mL) ranged from 6.1 -

46. 66.0% of the participants had S. Vitamin D: Deficient. 26.0% of the participants had S. Vitamin D: Insufficient. 8.0% of the participants had S. Vitamin D: Sufficient. The mean (SD) of ESR (mm/Hr) was $54.56 (30.82)$. The mean (SD) of CRP was $2.50 (1.74)$. The CRP ranged from 0.6 - 4.8. The mean (SD) of S. Calcium (mg/dL) was $8.27 (1.60)$. The mean (SD) of S. Albumin (g/dL) was $3.67 (0.72)$. The mean (SD) of Bone specific ALP was $119.38 (56.14)$. The mean (SD) of Hemoglobin (g/dL) was $11.14 (2.07)$. The Hemoglobin (g/dL) ranged from 1.7 - 14.3. The mean (SD) of TLC (/cu.mm) was $12316.00 (4642.10)$.

The mean (SD) of age in the group A was 44.00 (12.43): in group B was 50.60 (10.16): in group C was 33.20 (11.32): in group D was 32.00 (9.12). There was a significant difference between the 4 groups in terms of age ($F = 5.735, p = 0.002$).

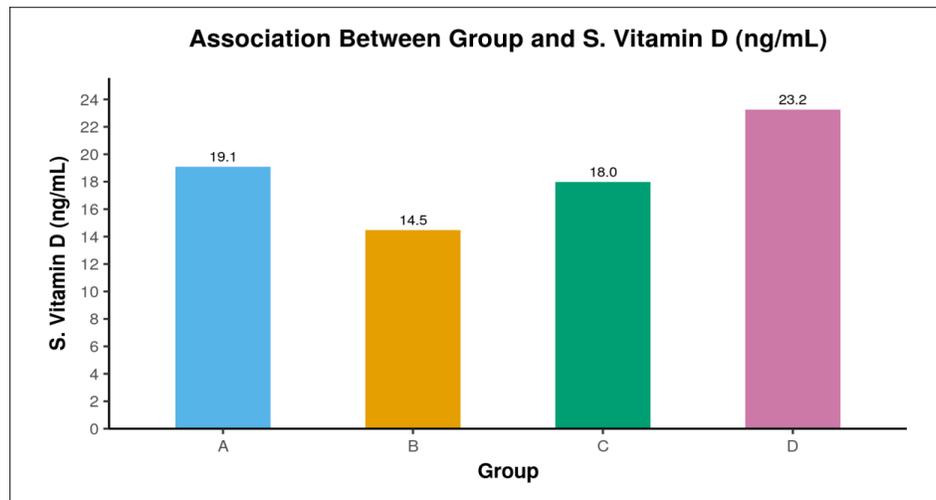
Table 1: Comparison of 4 subgroups of the variable groups in terms of age (years), n=50

Age (Years)	Group				On-Way ANOVA	
	A	B	C	D	F	p- value
Mean (SD)	44.00 (12.43)	50.60 (10.16)	33.20 (11.32)	32.00 (9.12)	5.735	0.002
Median (IQR)	45 (32-52)	55 (46-57)	30.5 (25.75-44.25)	31 (26.75-34.5)		
Range	27-65	35-60	17-54	20-50		

The mean (SD) of S. Vitamin D (ng/mL) in the Group: A group was 19.09 (7.10). The mean (SD) of S. Vitamin D (ng/mL) in the Group: B group was 14.48 (5.63). The mean (SD) of S. Vitamin D (ng/mL) in the Group: C group was 17.98 (7.36). The mean (SD) of S. Vitamin D (ng/mL) in the Group: D group was 23.24 (10.56). There was no significant difference between the groups in terms of S. Vitamin D (ng/mL) ($F = 1.620, p = 0.198$).

Table 2: Comparison of the 4 Subgroups of the Variable Group in Terms of S. Vitamin D (ng/mL) (n = 50)

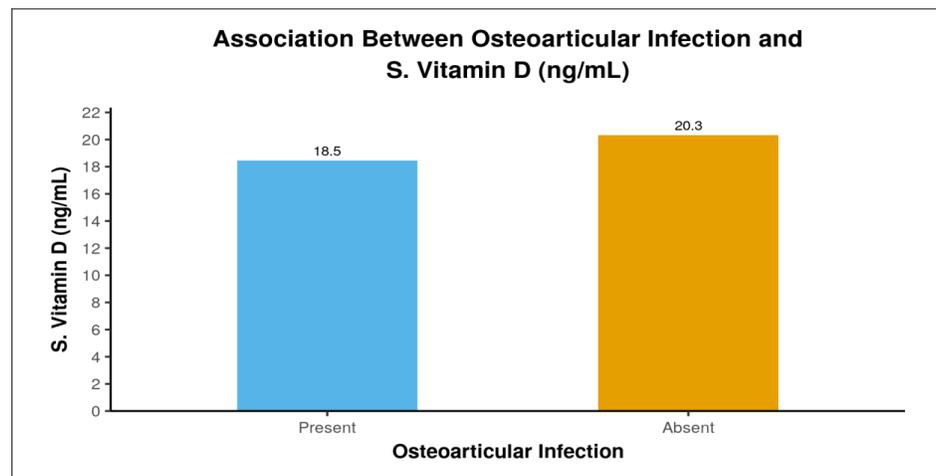
S. Vitamin D	Group				On-Way ANOVA	
	A	B	C	D	F	p- value
Mean (SD)	19.09 (7.10)	14.48 (5.63)	17.98 (7.36)	23.24 (10.56)	1.620	0.198
Median (IQR)	18.4 (14.95-21.4)	13.9 (10.6-15.1)	16.5 (13.3-20.3)	21.8 (15.77-26)		
Range	27-65	9.2-23.6	6.1-37	10.5-46		



Graph 1: Means of S. Vitamin D (ng/mL) in the 4 different groups.

The correlation analysis indicated that group A had a moderate negative correlation between age and S. Vitamin D (ng/mL), ($r = -0.31$, $p = 0.256$). Weak negative correlation was found in group B ($r = -0.01$, $p = 0.988$). Correlation was weak positive in group C ($r = 0.14$, $p = 0.545$) and a weak negative correlation was marked in group D ($r = -0.13$, $p = 0.719$). No statistically significant correlation was found from any of the groups.

The variable S. Vitamin D (ng/mL) was normally distributed in the 2 subgroups of the variable osteoarticular infection (present or absent). Thus, parametric tests (t-test) were used to make group comparisons. There was no significant difference between the groups in terms of S. Vitamin D (ng/mL) ($t = -0.657$, $p = 0.519$).



Graph 2: Means of S. Vitamin D (ng/mL) in the 2 different groups

The mean (SD) of S. Vitamin D (ng/mL) in the Group: A+B group was 17.93 (6.93). The mean (SD) of S. Vitamin D (ng/mL) in the Group: C+D group was 19.73 (8.74). The S. Vitamin D (ng/mL) in the Group: A+B

ranged from 8.4 - 38. The S. Vitamin D (ng/mL) in the Group: C+D ranged from 6.1 - 46.

There was no significant difference between the groups in terms of S. Vitamin D (ng/mL) ($W = 269.500$, $p = 0.552$).

Discussion

Vitamin D metabolism is complex but well known and researched. Today, we know that its homeostasis depends not only on adequate nutritional intake but also on intact kidney and liver function as well as sufficient exposure to sunlight [6]. Previous studies have linked vitamin D with several other immunological alterations that are associated with increased susceptibility to infection [7]. The present study was focused on patients with osteoarticular infection and their serum vitamin D status.

The mean (SD) of S. Vitamin D (ng/mL) in the Group: A group was 19.09 (7.10). The mean (SD) of S. Vitamin D (ng/mL) in the Group: B group was 14.48 (5.63). The mean (SD) of S. Vitamin D (ng/mL) in the Group: C group was 17.98 (7.36). The mean (SD) of S. Vitamin D

(ng/mL) in the Group: D group was 23.24 (10.56). The S. Vitamin D (ng/mL) in the Group: A ranged from 8.4 - 38. The S. Vitamin D (ng/mL) in the Group: B ranged from 9.2 - 23.6. The S. Vitamin D (ng/mL) in the Group: C ranged from 6.1 - 37. The S. Vitamin D (ng/mL) in the Group: D ranged from 10.5 - 46. There was no significant difference between the groups in terms of S. Vitamin D (ng/mL) ($F = 1.620$, $p = 0.198$). There was also no significant difference between the osteoarticular infection group and non-infectious group in terms of S. Vitamin D (ng/mL) ($t = -0.657$, $p = 0.519$). These results were in accordance with Signore *et al* (2015) [8].

Tiwari *et al.* (2014) [7] showed a high prevalence of vitamin D deficiency in patients with diabetic foot infection: 125 patients with diabetic foot infection were compared with diabetic patients without

infection, vitamin D deficiency was prevalent and severe in patients with diabetic foot infection. Their study supported present analysis.

Maier *et al.* (2014) [9] found an association between an extremely low vitamin D level and periprosthetic joint infections. The authors concluded that vitamin D supplementation could be a safe and easy way to reduce the risk of periprosthetic joint infection.

Signore *et al* (2015) [8], all patients with an osteoarticular infection showed a higher serum level of vitamin D (17.7 ± 5.3 ng/mL) than the noninfected patients (15.1 ± 5.6 ng/mL). In a study by Traven *et al* in 2017 pointing to the importance of vitamin D in periprosthetic joint infections, a retrospective study of 126 revisions arthroplasty after total hip joint arthroplasty was done. They found that a low vitamin D level was associated with an increased risk of complications, especially periprosthetic joint infections.

We found that patient with periprosthetic joint infection presented with vitamin D deficiency mean 19.09 ± 7.10 and patient with aseptic failure had low serum vitamin d level 14.48 ± 5.63 in comparison with osteoarticular infection patients. In a study from Signore *et al.* (2015) [8] described a lower level of serum vitamin D level in patients of aseptic loosening in comparison to periprosthetic joint infection.

Conclusion

In the end of the study it was concluded that patients with osteoarticular infection had vitamin D deficiency. However, statistically significant correlation between lower level of serum vitamin D level in comparison to non-infectious disease was not found.

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