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Research Article

Role of Vitamin D3 Supplementation in the Management of Chronic Rhinosinusitis without Nasal Polyposis: A Prospective Comparative Study

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ABSTRACT

Background: Chronic rhinosinusitis (CRS) is a common inflammatory condition of the paranasal sinuses that significantly affects quality of life. Emerging evidence suggests a potential role of vitamin D in immune modulation and inflammation; however, its therapeutic role in CRS remains uncertain. **Objective:** To evaluate the effect of oral vitamin D3 supplementation on clinical symptoms and radiological outcomes in patients with chronic rhinosinusitis without nasal polyposis (CRSsNP)**. Methods:** This prospective study was conducted over a period of two years and included 60 patients diagnosed with CRSsNP and vitamin D deficiency. Participants were randomly divided into two groups: the intervention group received oral vitamin D3 supplementation along with standard therapy, while the control group received placebo with standard therapy. Symptom severity was assessed using the Sinonasal Outcome Test-22 (SNOT-22), and radiological evaluation was performed using the Lund–Mackay scoring system at baseline and after follow-up. Serum vitamin D levels were measured at baseline and at the end of the study. **Results:** Baseline characteristics were comparable between the two groups ($p > 0.05$). At baseline, there was no significant difference in SNOT-22 scores between the groups. After 4 months, the vitamin D3 group showed a significant reduction in SNOT-22 scores (44.2 ± 9.1) compared to the placebo group (53.4 ± 7.2) ($p < 0.0001$). Similarly, Lund–Mackay scores showed a greater reduction in the vitamin D group (from 16.2 ± 2.1 to 7.9 ± 1.9) compared to the placebo group (from 14.7 ± 1.8 to 11.7 ± 2.3). Serum vitamin D levels increased significantly in the intervention group ($p < 0.0001$). **Conclusion:** Oral vitamin D3 supplementation, as an adjunct to standard therapy, significantly improves clinical symptoms and radiological outcomes in patients with CRSsNP. It may serve as a beneficial, cost-effective therapeutic option in the management of CRS.

Keywords: Chronic rhinosinusitis, Vitamin D3, SNOT-22, Lund–Mackay score, inflammation, supplementation

INTRODUCTION

Chronic rhinosinusitis (CRS) is a common inflammatory disorder of the paranasal sinuses and nasal mucosa, characterized by symptoms such as nasal obstruction, nasal discharge, facial pain or pressure, and reduction or loss of smell persisting for more than 12 weeks [1]. It represents a significant global health problem, affecting approximately 10–15% of the population, and is associated with considerable impairment in quality of life and productivity [2]. CRS is broadly classified into chronic rhinosinusitis with nasal polyposis (CRSwNP) and without nasal polyposis (CRSsNP), each having distinct pathophysiological mechanisms [3].

The pathogenesis of CRS is multifactorial, involving complex interactions between host immunity, environmental factors, microbial agents, and inflammatory mediators [4]. Increasing evidence suggests that immune dysregulation plays a central role in the development and persistence of CRS, making immunomodulatory therapies a potential area of interest [5]. Vitamin D, a fat-soluble secosteroid hormone, is well known for its role in calcium homeostasis and bone metabolism. However, recent studies have highlighted its significant immunomodulatory and anti-inflammatory properties [6]. Vitamin D influences both innate and adaptive immune responses by regulating cytokine production, inhibiting pro-inflammatory pathways, and promoting antimicrobial peptide synthesis [7]. Deficiency of vitamin D has been associated with increased susceptibility to infections, chronic inflammatory conditions, and impaired mucosal immunity [8]. Several studies have demonstrated a correlation between low serum vitamin D levels and increased severity of CRS [9]. Vitamin D deficiency has been linked to enhanced sinonasal inflammation, increased disease burden, and poorer clinical outcomes [10]. Moreover, alterations in local vitamin D metabolism within sinonasal tissues have been reported, suggesting a role in disease pathophysiology independent of systemic levels [11].

Despite growing evidence, the therapeutic role of vitamin D supplementation in CRS remains controversial. While some studies have shown improvement in symptoms and inflammatory markers following supplementation, others have reported inconsistent results [12]. Therefore, further clinical studies are needed to clarify its efficacy, particularly in patients with chronic rhinosinusitis without nasal polyposis. In this context, the present study was undertaken to evaluate the effect of oral vitamin D3 supplementation on clinical symptoms and radiological outcomes in patients with CRS without nasal polyposis, using validated tools such as the Sinonasal Outcome Test-22 (SNOT-22) and Lund–Mackay scoring system.

Materials and Methods

This prospective study was carried out at Department of ENT and Biochemistry, AIMMMCR, Junwani, Bhilai, Chhattisgarh, India. A total of 60 patients diagnosed with chronic rhinosinusitis without nasal polyposis (CRSsNP) and concomitant vitamin D deficiency were enrolled in the study.

Inclusion Criteria

Participants were selected based on the following criteria:

- Age between 18 and 60 years
- Diagnosis of CRSsNP based on established clinical criteria
- Serum vitamin D3 levels below 20 ng/mL

Exclusion Criteria

Patients were excluded if they met any of the following conditions:

- Refusal to provide informed consent
- Presence of nasal polyps or prior surgical intervention for CRS, including functional endoscopic sinus surgery (FESS)
- Known hypersensitivity to oral vitamin D3
- History of prolonged systemic corticosteroid therapy
- Presence of systemic illnesses such as endocrine, renal, skeletal disorders, or malignancy
- Ongoing vitamin D supplementation
- Smoking or excessive alcohol consumption
- Pregnancy

Methodology

Written informed consent was obtained from all participants prior to inclusion in the study. The eligible patients were randomly allocated into two groups, each comprising 30 individuals: the intervention group (vitamin D3 group) and the control group (placebo group).

Both groups received a standardized treatment regimen consisting of intranasal fluticasone spray, a short course of antibiotics for five days, and montelukast therapy for one month. In addition to this, the intervention group was administered oral vitamin D3 at a dose of 400 IU daily for one month, whereas the control group received a placebo for the same duration.

Data collection was performed using structured questionnaires. Clinical outcomes were assessed at baseline, at one month, and at four months following treatment initiation. Quality of life (QoL) was evaluated using the Sino-Nasal Outcome Test-22 (SNOT-22), a validated instrument comprising 22 items categorized into nasal, otologic, sleep-related, and emotional domains.

At the end of four months, all patients underwent computed tomography (CT) scanning of the paranasal sinuses. Disease severity was graded using the Lund–Mackay scoring system, a widely accepted radiological staging method in CRS. Each sinus was assigned a score ranging from 0 to 2, resulting in a total possible score between 0 and 24.

Statistical Analysis

All data were entered into Microsoft Excel and analyzed using MedCalc software. Results are presented along with p-values and 95% confidence intervals (CI). The p-value was used to determine the statistical significance of differences between groups,

based on the null hypothesis that no difference exists between them. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 60 patients were included in the study and were equally divided into two groups: the Vitamin D3 group and the placebo group (n = 30 each). The overall study population consisted of 34 males and 26 females, with a male-to-female ratio of 1.31:1.

The mean age of patients in the Vitamin D3 group was 35.02 ± 7.5 years, while in the placebo group it was 36.2 ± 6.8 years. There was no statistically significant difference between the two groups with respect to age, gender distribution, or the presence of allergic rhinitis ($p > 0.05$), indicating that both groups were comparable at baseline.

At baseline (0 month), the mean SNOT-22 scores were similar in both groups (Vitamin D3: 69.5 ± 6.3; Placebo: 70.3 ± 7.9), with no significant difference. After 1 month of treatment, both groups showed minimal change, and the difference remained statistically non-significant ($p > 0.05$). However, by 2 months, a marked reduction in SNOT-22 scores was observed in both groups, with the Vitamin D3 group demonstrating a significantly greater improvement (44.2 ± 9.1) compared to the placebo group (53.4 ± 7.2), which was statistically highly significant ($p < 0.0001$).

Similarly, Lund–Mackay scores showed a reduction over time in both groups. The Vitamin D3 group demonstrated a greater decrease from 16.2 ± 2.1 at baseline to 7.9 ± 1.9 at 2 months, whereas the placebo group showed a smaller reduction from 14.7 ± 1.8 to 11.7 ± 2.3. This improvement was statistically significant, with a more pronounced effect in the Vitamin D3 group.

In the Vitamin D3 group, serum vitamin D levels increased significantly from a baseline value of 16.3 ± 3.4 to 30.1 ± 2.9 after 4 months of supplementation ($p < 0.0001$), confirming effective correction of vitamin D deficiency.

Overall, the observations indicate that Vitamin D3 supplementation resulted in significant clinical and radiological improvement compared to placebo.

Table 1: This table shows baseline characteristics of both groups of patients

Variables		***Vitamin D3 group***	***Placebo group***	***P-value***
Age (mean±SD)		35.02±7.5	36.2±6.8	0.52(NS)
Gender	Male	16	18	0.60(NS)
	Female	14	12	
Allergic rhinitis	Prasent	11	13	0.59(NS)
	Absent	19	17	

Of the 60 cases included in our study, 34 were male and 26 were female, resulting in a male-to-female ratio of 1.31. The mean age of participants in the vitamin D3 group was 35.02±7.5 years, while the mean age in the Placebo group was 36.2±6.8 years. The baseline characteristics are presented in Table 1

Table 2: This table shows changes in SNOT-22 in both groups score

Time Point	Vitamin D3	Placebo	P-value
0 month	69.5±6.3	70.3±7.9	**0.70 (NS)**
1 month	66.8±8.9	68.3±8.3	**0.50 (NS)**
2 months	44.2±9.1	53.4±7.2	**<0.0001 (HS)**

Table 3: This table shows changes in Lund-Mackay scores in both groups score

Time Point	Vitamin D3	Placebo	P-value
Baseline	16.2±2.1	14.7±1.8	**0.005 (S)**
2 months	7.9±1.9	11.7±2.3	**<0.0001 (HS)**

Table 4: This table shows vitamin D3 levels before and after supplementation in vitamin D3 group

Test group	0 month	4 months	P-value
D3 level (Mean±SD)	16.3±3.4	30.1±2.9	<0.0001 (HS)

In the group of vitamin D3, the mean vitamin D levels significantly increased from 16.5 ± 0.3 at baseline (0 month) to 30.1 ± 2.9 after 4 months of supplementation ($p < 0.0001$). This is shown in Table 4.

DISCUSSION

Chronic rhinosinusitis (CRS) is a common inflammatory condition that significantly affects quality of life and contributes to substantial healthcare costs worldwide [1]. Its multifactorial etiology has prompted ongoing research into adjunctive therapies targeting underlying inflammatory and immunological mechanisms [3]. Among these, vitamin D has gained attention due to its immunomodulatory properties, although its exact role in CRS management remains to be fully elucidated [6].

In the present study, oral vitamin D3 supplementation resulted in a significant increase in serum vitamin D levels, indicating adequate compliance, absorption, and therapeutic dosing. Symptomatic assessment using the Sinonasal Outcome Test-22 (SNOT-22), a validated instrument for CRS evaluation, demonstrated a progressive reduction in symptom scores, with significantly greater improvement observed in the vitamin D group at the end of the study period [13]. These findings suggest that vitamin D3 supplementation may contribute to meaningful symptomatic relief in CRS patients.

The improvement in clinical outcomes was paralleled by a significant rise in serum vitamin D levels, supporting the biological plausibility of the intervention. Previous studies have reported similar findings, indicating improved symptom control following vitamin D supplementation [12]. While Zaidi et al. observed gender-based differences

in quality of life outcomes, with females reporting higher symptom burden, such differences were not evident in our study population [14].

At the molecular level, Christensen et al. highlighted the localized regulation of vitamin D metabolism within sinonasal tissues, independent of systemic levels [11]. Altered expression of CYP27B1 and CYP24A1 enzymes suggests impaired activation and increased degradation of vitamin D locally, which may contribute to persistent inflammation in CRS.

Vitamin D exerts significant immunomodulatory effects by regulating cytokine production and immune cell differentiation. Abuzeid et al. demonstrated its role in reducing inflammatory responses in chronic airway diseases [8]. Similarly, Sansoni et al. reported that vitamin D3 modulates basic fibroblast growth factor (bFGF), a key mediator of tissue remodeling and inflammation in sinonasal mucosa [15].

Radiological assessment using the Lund–Mackay scoring system revealed a statistically significant reduction in sinus disease severity in the vitamin D group compared to placebo, indicating objective improvement in sinus pathology [16].

The relevance of vitamin D supplementation is particularly important in the Indian context, where vitamin D deficiency is prevalent despite abundant sunlight due to lifestyle and environmental factors [17]. Baruah et al. emphasized the role of supplementation and food fortification strategies in improving vitamin D status [18]. Furthermore, Mulligan et al. demonstrated that vitamin D deficiency exacerbates sinonasal inflammation [10], while a meta-analysis by Li et al. confirmed a significant association between low serum vitamin D levels and CRS prevalence [9]. Heaney's work further underscores the broader physiological and immunological importance of vitamin D beyond bone health [19]. Schlosser et al. reported a correlation between low vitamin D levels and increased CT severity scores [20], while Zand et al. demonstrated clinical and biochemical improvement following vitamin D supplementation [12].

CONCLUSION

Oral vitamin D3 supplementation, when used as an adjunct to standard therapy, appears to provide significant clinical and radiological benefits in patients with chronic rhinosinusitis without nasal polyposis. These findings support the potential role of vitamin D in CRS management. However, larger randomized controlled trials with longer follow-up durations are required to confirm these results and establish definitive treatment guidelines.

CLINICAL SIGNIFICANCE

Vitamin D supplementation represents a simple, cost-effective, and accessible adjunctive therapy in the management of CRS. Routine screening and correction of vitamin D deficiency may improve symptom control, enhance quality of life, and optimize treatment outcomes. Incorporating vitamin D assessment into routine clinical practice may facilitate a more personalized approach to CRS management.

LIMITATIONS

This study has certain limitations. The relatively small sample size may limit the generalizability of the findings. Additionally, the follow-up duration of four months may not adequately capture long-term outcomes or recurrence patterns. All participants received standard therapy along with vitamin D or placebo, making it difficult to isolate the independent effect of vitamin D supplementation. The use of subjective tools such as SNOT-22 and radiological scoring systems may introduce observer and reporting bias. Furthermore, inflammatory biomarkers were not assessed, which could have provided additional insights into the mechanistic role of vitamin D. Future studies with larger sample sizes, longer follow-up, and inclusion of immunological markers are recommended.

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