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Original Research Article

Vitamin D Status and Its Association with Benign Paroxysmal Positional Vertigo: A Clinical Study

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Abstract:

Background: Benign paroxysmal positional vertigo (BPPV) is a common vestibular disorder with a considerable risk of recurrence. Vitamin D deficiency may contribute to otoconia dysfunction and recurrent BPPV. This study evaluated the effect of vitamin D supplementation on BPPV recurrence.

Methods: This comparative interventional study included 122 patients with BPPV. Participants were randomly allocated into two groups of 61 each. Group A received vitamin D supplementation with canal repositioning manoeuvre (CRM), while Group B received CRM alone. Serum 25(OH)D levels and recurrent BPPV episodes were assessed over 6 months.

Results: Baseline vitamin D levels were comparable between Group A and Group B (12.6 ± 2.4 vs. 12.4 ± 2.2 ng/mL; $p = 0.63$). After 6 months, levels increased to 26.8 ± 4.6 ng/mL in Group A and remained 12.5 ± 2.3 ng/mL in Group B ($p < 0.001$). The mean number of recurrent episodes was lower in Group A than in Group B (0.3 ± 0.5 vs. 1.4 ± 0.8; $p < 0.001$). Recurrence-free status was observed in 78.7% and 44.3% of patients, respectively.

Conclusion: Vitamin D supplementation with CRM improved vitamin D levels and reduced BPPV recurrence compared with CRM alone.

Keywords: Benign paroxysmal positional vertigo; Vitamin D deficiency; Canal repositioning manoeuvre; Recurrence; 25-hydroxyvitamin D.

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Introduction

Benign paroxysmal positional vertigo (BPPV) is the most common peripheral vestibular disorder and is characterised by brief, recurrent episodes of vertigo triggered by changes in head position [1-3]. It commonly affects older adults and occurs when displaced calcium carbonate crystals (otoconia) enter the semicircular canals, most frequently the posterior canal, causing abnormal stimulation of the vestibular sensory system [4, 5]. Although canal repositioning manoeuvres are effective in relieving symptoms, recurrence is common, highlighting the importance of identifying factors that may contribute to otoconia dislodgement and impaired vestibular homeostasis [6].

Otoconia are biomineralised structures composed predominantly of calcium carbonate embedded within an organic matrix. Their formation, density, and maintenance depend on tightly regulated calcium metabolism and matrix organisation [7, 8]. Vitamin D plays an important role in calcium and phosphate absorption, deposition, and mineralisation, and its receptors are expressed in the inner ear, including structures involved in calcium regulation [9]. Consequently, disturbances in vitamin D status may affect otoconia formation and stability, potentially increasing susceptibility to BPPV.

Several studies have reported an association between low serum vitamin D levels and BPPV, particularly its recurrence [10-12]. This relationship may be partly explained by similarities between otoconia and bone biomineralisation, as both processes require regulated calcium metabolism. Conditions associated with altered calcium homeostasis, such as osteopenia and osteoporosis, have also been linked to BPPV [13]. However, the association between vitamin D deficiency and BPPV may be influenced by age, lifestyle, sunlight exposure, nutritional status, and other clinical factors, and further evaluation in different patient populations is warranted.

The present study therefore aims to assess serum vitamin D levels in patients with BPPV and determine their association with recurrent attacks.

Establishing the prevalence of vitamin D deficiency and its relationship with recurrence may help clarify the potential role of vitamin D status in BPPV management and provide a basis for evaluating whether vitamin D supplementation could contribute to reducing recurrent episodes.

Methods

Study design and setting: This hospital-based comparative interventional study was conducted in the Department of Otorhinolaryngology at a tertiary care hospital over a period of one year. The study included patients clinically diagnosed with benign paroxysmal positional vertigo (BPPV) who attended the outpatient department.

Study population and sample size: The study population comprised adult patients diagnosed with BPPV based on clinical history and positional testing. A total of 122 patients were recruited using consecutive sampling and randomly allocated into two groups of 61 patients each. Group A received vitamin D supplementation along with canal repositioning manoeuvre (CRM), whereas Group B received CRM alone.

Inclusion criteria: Adults aged ≥18 years with a clinical diagnosis of BPPV, characterised by recurrent episodes of positional vertigo or dizziness triggered by head movements, were included. The diagnosis was supported by characteristic positional nystagmus elicited during the Dix–Hallpike manoeuvre or other appropriate positional tests.

Exclusion criteria: Patients with recent head or ear trauma, otologic surgery, ear infection, active inner-ear disease, or other vestibular disorders were excluded. Patients with chronic renal, hepatic, gastrointestinal, haematological, or cardiovascular diseases; those receiving vitamin D or calcium supplementation or medications affecting vitamin D metabolism; and those with incomplete data or unwillingness to provide consent were also excluded.

Study procedure: After obtaining informed consent, eligible participants underwent detailed history-taking and clinical examination, including assessment of spontaneous, positional, and positioning nystagmus. Demographic and clinical details, including age, sex, duration of symptoms, and history of previous BPPV episodes, were recorded. Baseline serum 25(OH)D levels were estimated before treatment. All participants underwent CRM, while Group A additionally received vitamin D supplementation according to the study protocol. Participants were followed up for 6 months, during which serum 25(OH)D levels and recurrent BPPV episodes were recorded.

Assessment of vitamin D status: Serum 25-hydroxyvitamin D [25(OH)D] levels were estimated at baseline and after 6 months using a standardised laboratory method. Vitamin D status was classified according to predefined criteria as deficient, insufficient, or sufficient.

Assessment of BPPV recurrence: Recurrence was defined as the reappearance of positional vertigo accompanied by characteristic positional nystagmus after complete resolution of the initial episode. The number of recurrent BPPV episodes during the 6-month follow-up was recorded and compared between the two groups.

Statistical analysis: Data were analysed using SPSS version 20. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Appropriate statistical tests were used to compare vitamin D levels and recurrence between the groups. A p-value <0.05 was considered statistically significant.

Ethical considerations: Written informed consent was obtained from all participants, and confidentiality was maintained throughout the study.

Results

The mean age of patients was comparable between the vitamin D supplementation + CRM group and the CRM-only group, with no statistically significant difference. The distribution of males and females was also similar between the groups. Baseline serum 25(OH)D levels were low in both groups and did not differ significantly, indicating comparable demographic characteristics and vitamin D status at enrolment (Table 1).

Table 1: Comparison of demographic characteristics and baseline vitamin D levels between the two groups

Variable	Vitamin D + CRM (Group A, n = 61)	CRM only (Group B, n = 61)	p-value
Age (years), mean ± SD	49.6 ± 8.1	50.1 ± 8.7	0.74
Sex, n (%)			
Males	19 (31.1%)	22 (36.1%)	0.56
Females	42 (68.9%)	39 (63.9%)	
Serum 25(OH)D at baseline (ng/mL), mean ± SD	12.6 ± 2.4	12.4 ± 2.2	0.63

After 6 months, the mean serum 25(OH)D level was significantly higher in the vitamin D supplementation + CRM group than in the CRM-only group. The mean number of recurrent BPPV episodes was also significantly lower in the supplementation group, suggesting an association between improved vitamin D status and reduced recurrence during follow-up (Table 2).

Table 2: Comparison of serum vitamin D levels and recurrence between the two groups after 6 months

Variable	Vitamin D + CRM (Group A, n = 61)	CRM only (Group B, n = 61)	p-value
Serum 25(OH)D after 6 months (ng/mL), mean ± SD	26.8 ± 4.6	12.5 ± 2.3	<0.001*
Number of recurrent BPPV episodes during the 6-month follow-up, mean ± SD	0.3 ± 0.5	1.4 ± 0.8	<0.001*

*statistically significant.

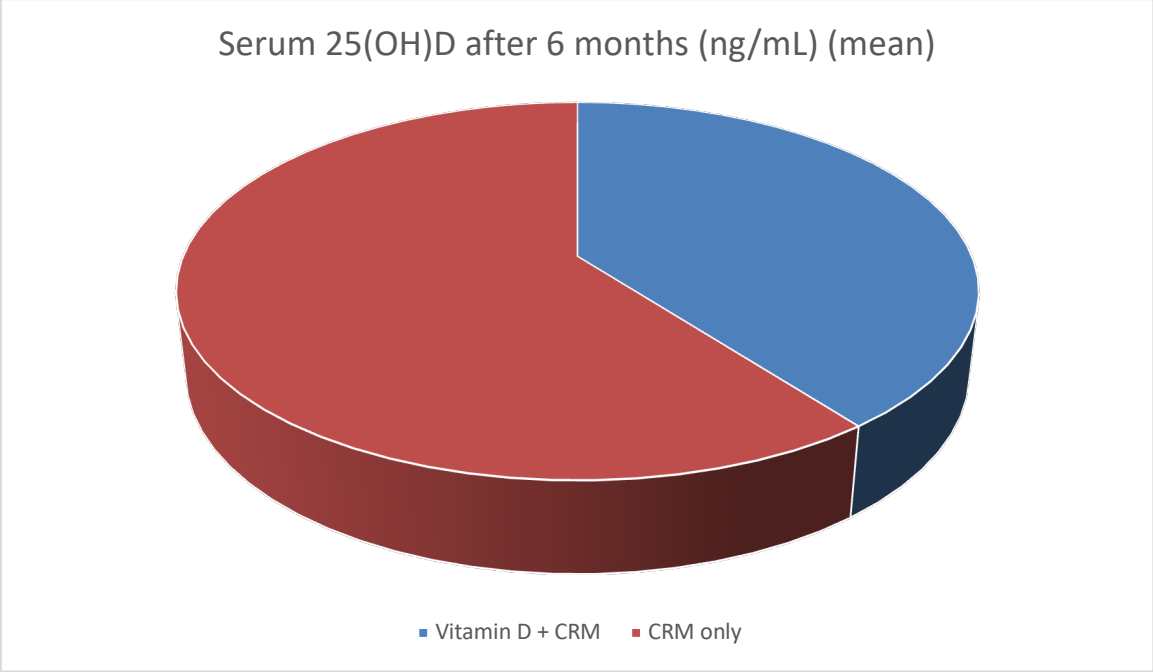

Figure 1: Comparison of Mean Serum 25(OH)D Levels After 6 Months

During the 6-month follow-up, 78.7% of patients in the vitamin D supplementation + CRM group experienced no recurrence, compared with 44.3% in the CRM-only group. A greater proportion of patients in the CRM-only group experienced one or more recurrent episodes, and the difference in recurrence distribution between the groups was statistically significant (Table 3).

Table 3: Comparison of the number of recurrent BPPV episodes during the 6-month follow-up period

Number of recurrent episodes	Vitamin D + CRM (Group A, n = 61)	CRM only (Group B, n = 61)	p-value
0 episodes	48 (78.7%)	27 (44.3%)	
1 episode	11 (18.0%)	22 (36.1%)	
2 episodes	2 (3.3%)	9 (14.8%)	
3 episodes	0 (0%)	3 (4.9%)	
Total	**61 (100%)**	**61 (100%)**	**0.001***

*statistically significant.

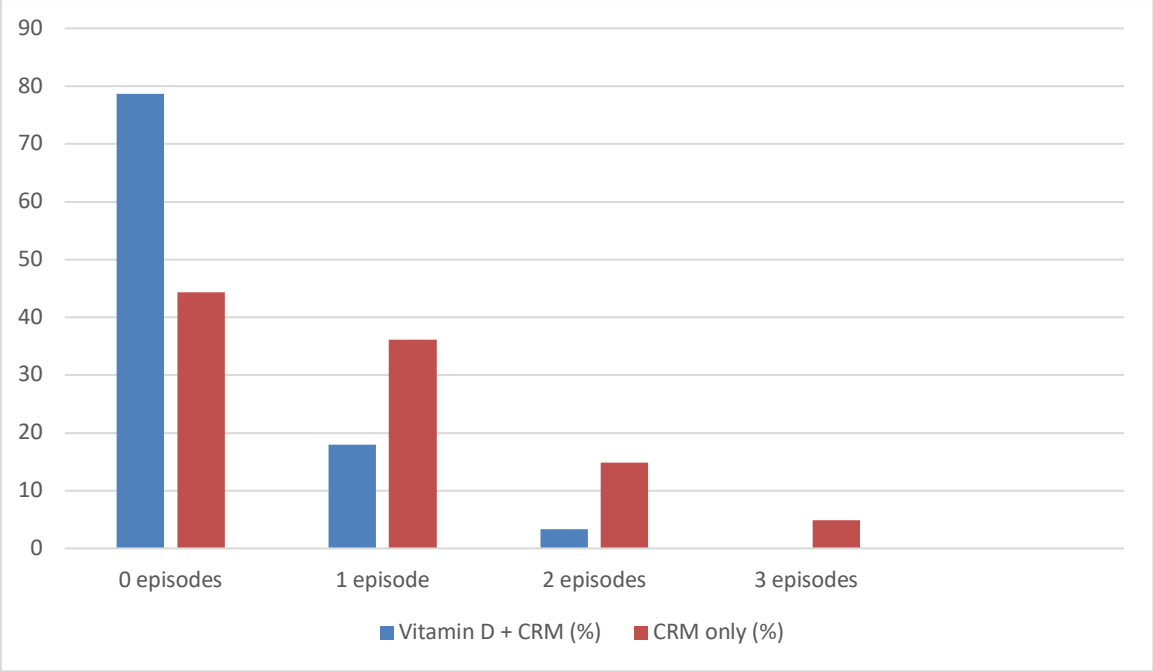

Figure 2: Distribution of Recurrent BPPV Episodes During the 6-Month Follow-up Period

Discussion

Vitamin D status is influenced by several demographic, environmental, and lifestyle-related factors, including inadequate sunlight exposure, clothing practices, advancing age, obesity, chronic illnesses, and seasonal changes. Although sunlight is a major source of vitamin D, insufficient exposure to ultraviolet B (UVB) radiation may result in reduced serum 25(OH)D concentrations even in regions with abundant sunshine. Seasonal variation in the occurrence of BPPV has been reported, with an increased number of clinical presentations during periods associated with lower vitamin D levels [14]. In the present study, both groups demonstrated low baseline serum 25(OH)D concentrations, with mean levels of 12.6 ± 2.4 ng/mL in Group A and 12.4 ± 2.2 ng/mL in Group B. The comparable baseline values indicate a similar degree of vitamin D deficiency before treatment. Although individuals living near the Equator may receive greater UVB exposure and consequently have higher vitamin D concentrations, lifestyle and environmental factors may still contribute to vitamin D deficiency [15].

The present study involved 122 patients with BPPV who were allocated to receive either vitamin D supplementation combined with CRM or CRM alone. The comparable demographic characteristics and baseline vitamin D concentrations suggest that the groups were sufficiently balanced before intervention. After 6 months, serum 25(OH)D levels increased to 26.8 ± 4.6 ng/mL in the vitamin D plus CRM group, whereas the level remained almost unchanged at 12.5 ± 2.3 ng/mL in the CRM-only group. This difference demonstrates the biochemical response to supplementation. Female participants constituted a greater proportion of both groups, although the difference was not statistically significant. A similar female predominance has been reported in a previous study involving BPPV and vitamin D deficiency [16]. The mean age of approximately 50 years in the present study was also comparable with previously reported findings [16].

A marked difference was observed in the recurrence of BPPV during the 6-month follow-up. The mean number of recurrent episodes per patient was 0.3 ± 0.5 in the vitamin D plus CRM group and 1.4 ± 0.8 in the CRM-only group. Moreover, 78.7% of patients receiving vitamin D supplementation remained free from recurrence, compared with 44.3% of patients treated with CRM alone. These findings indicate that vitamin D supplementation may provide an additional preventive benefit when combined with CRM. BPPV recurrence has been reported in approximately 30–50% of patients over 3-5 years and may be associated with female sex, older age, ear disorders, lateral semicircular canal involvement, chronic illnesses, and vitamin D deficiency [17, 18]. Previous evidence has also demonstrated a reduction in recurrent BPPV episodes following vitamin D treatment during a 6-month follow-up period [16]. Similarly, lower vitamin D levels have been observed among patients with recurrent BPPV, with no further episodes reported during follow-up after supplementation [19].

The association between vitamin D status and BPPV recurrence may be related to the role of vitamin D in calcium regulation, bone metabolism, and maintenance of otoconial structure. Disturbances in mineral metabolism may contribute to otoconia

degeneration or displacement, thereby increasing the likelihood of recurrent symptoms. A meta-analysis reported significantly lower vitamin D levels among patients with recurrent BPPV and identified a higher frequency of recurrence in individuals with osteoporosis [20]. Other studies have also documented low vitamin D concentrations in patients with BPPV and a reduction in recurrent attacks following supplementation [21]. The relationship between BPPV, osteoporosis, and reduced bone density has further supported the possible involvement of altered skeletal metabolism in the development and recurrence of the condition [22, 23]. Patients with idiopathic BPPV have been reported to exhibit lower serum 25(OH)D levels and a higher prevalence of vitamin D insufficiency than healthy controls [24]. Both vitamin D insufficiency and deficiency have also been associated with BPPV and its recurrent form [25]. Maintaining adequate vitamin D levels through supplementation and safe sunlight exposure has therefore been suggested as a preventive approach. In addition, vitamin D supplementation in vitamin D-deficient patients with posterior semicircular canal BPPV has been associated with a lower recurrence rate than in patients who did not receive supplementation [10]. The findings of the present study are consistent with this evidence and suggest that correcting vitamin D deficiency may be a useful adjunct to CRM for reducing recurrent BPPV episodes.

Conclusion

In the present study involving 122 patients with BPPV, vitamin D supplementation combined with canal repositioning manoeuvre (CRM) resulted in a significant improvement in serum 25(OH)D levels and a lower frequency of recurrent BPPV episodes compared with CRM alone over a 6-month follow-up period. The greater proportion of recurrence-free patients in the supplementation group suggests that correction of vitamin D deficiency may contribute to reducing BPPV recurrence. Therefore, assessment and management of vitamin D status may be considered as an adjunct to standard CRM, particularly in patients with vitamin D deficiency, although further studies with larger samples and longer follow-up are warranted to confirm these findings.

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