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Original Research Article

Association of Vitamin D Deficiency in Patients with Benign Paroxysmal Positional Vertigo - A Retrospective Study

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ABSTRACT

Background: Benign paroxysmal positional vertigo (BPPV) is the most common peripheral vestibular disorder and is characterized by recurrent episodes of positional vertigo. Emerging evidence suggests that vitamin D deficiency may contribute to the development and recurrence of BPPV through its role in calcium metabolism and otoconial homeostasis.

Objective: To evaluate the prevalence of vitamin D deficiency in patients with BPPV and determine its association with disease recurrence.

Methods: This retrospective observational study was conducted at the Department of Otorhinolaryngology, Sri Ramkrishna Institute of Medical Sciences and Sanaka Hospitals, West Bengal, India. Medical records of adult patients diagnosed with BPPV between January 2023 and December 2025 were reviewed. Patients with documented serum 25-hydroxyvitamin D [25(OH)D] levels and complete follow-up records were included.

Results: Eighty-two patients were included, of whom 38 (46.3%) experienced recurrence. Recurrent patients were significantly older than non-recurrent patients (54.1 ± 9.8 vs. 45.5 ± 7.3 years, $p<0.001$). Mean serum vitamin D levels were significantly lower in the recurrent group (23.7 ± 7.1 ng/mL) compared with the non-recurrent group (29.7 ± 6.0 ng/mL, $p<0.001$). Recurrence occurred in 75.0% of vitamin D-deficient patients, 72.4% of insufficient patients, and 19.5% of patients with sufficient vitamin D levels ($p<0.001$). Multivariable analysis identified increasing age (aOR 1.10, 95% CI 1.03–1.17, $p=0.004$) and lower vitamin D levels (aOR 0.91, 95% CI 0.84–0.99, $p=0.029$) as independent predictors of recurrence.

Conclusions: Lower serum vitamin D levels and advancing age are independently associated with recurrent BPPV. Assessment and correction of vitamin D deficiency may represent a simple and potentially effective strategy for reducing recurrence in susceptible patients.

Keywords: Benign Paroxysmal Positional Vertigo, BPPV, Vitamin D Deficiency, Recurrence, Vestibular Disorders, Otoconia.

INTRODUCTION

Benign Paroxysmal Positional Vertigo (BPPV) is the most prevalent vestibular disorder, characterized by brief episodes of vertigo triggered by specific head movements. It accounts for approximately 20–30% of patients presenting with dizziness in otolaryngology clinics and significantly affects quality of life, particularly in older adults.[1] It is also more frequently seen in females than males, with most epidemiological studies reporting a female-to-male ratio ranging from 1.5:1 to 2.5:1, possibly due to hormonal influences on calcium metabolism and otoconial integrity.[2]

The underlying pathology involves displacement of otoconia from the utricle into the semicircular canals, most commonly the posterior canal, leading to abnormal stimulation of vestibular receptors during head movements.[3] Recent evidence has suggested a potential association between vitamin D deficiency and the development and recurrence

of BPPV. Vitamin D plays a crucial role in calcium metabolism and otoconial homeostasis within the inner ear.[4] Deficiency of vitamin D may impair the structural integrity of otoconia, increasing their susceptibility to degeneration and displacement.[5] Several observational studies have demonstrated significantly lower serum 25-hydroxyvitamin D levels in patients with BPPV compared with healthy controls.[6]

Recurrence remains a major challenge in the management of BPPV despite successful repositioning maneuvers. Reported recurrence rates vary from 15% to 50% depending on the duration of follow-up.[7] Emerging evidence suggests that vitamin D deficiency may be an important modifiable risk factor contributing to recurrent episodes.[8] Furthermore, vitamin D supplementation has been shown to reduce recurrence rates in susceptible individuals.[9]

Despite growing international evidence, data regarding the association between vitamin D deficiency and recurrence of BPPV in the Indian population remain limited. Therefore, this retrospective study was undertaken to evaluate the prevalence of vitamin D deficiency among patients with BPPV and to determine its association with disease recurrence.

MATERIALS AND METHOD

Population and Sample Collection

This retrospective observational study was conducted in the Department of Otorhinolaryngology at Sri Ramkrishna Institute of Medical Sciences (SRIMS) and Sanaka Hospitals, West Bengal, India. Medical records of all patients diagnosed with benign paroxysmal positional vertigo (BPPV) between January 2023 and December 2025 were reviewed.

Inclusion Criteria

The study included patients above 18 years of age with a clinical diagnosis of BPPV confirmed by a positive Dix hallpike or supine roll test, with a documented serum 25-hydroxyvitamin D [25(OH)D] levels, and a complete follow-up record.

Exclusion Criteria

Patients who had central causes of vertigo, other vestibular disorders (e.g., Vestibular neuritis and Meniere's disease), metabolic conditions affecting vitamin D metabolism, prior vitamin D supplementation were excluded. Only patients with complete documented clinical records of first visit and subsequent follow ups were included in the study.

Data collected included age, sex, affected ear, canal involved, comorbidities, serum vitamin D levels, treatment details, and recurrence status. Data regarding follow up visits and patients condition following canalith repositioning manoeuvre were also collected. Serum vitamin D levels were categorized as deficient (<20 ng/mL), insufficient (20–29 ng/mL), and sufficient (≥30 ng/mL).[10]

Recurrence was defined as the reappearance of positional vertigo with a positive Dix–Hallpike or Supine Roll test at least one month after complete symptom resolution following successful canalith repositioning manoeuvre.[3]

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were summarized as frequencies and percentages. Normality of continuous variables was assessed using the Shapiro–Wilk test. Comparisons between recurrent and non-recurrent groups were performed using the independent samples t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. Variables of established clinical relevance to BPPV recurrence, namely age, sex, and serum vitamin D level, were entered into a multivariable logistic regression model to identify independent predictors of recurrence. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated. A two-sided p-value <0.05 was considered statistically significant.

RESULTS

A total of 82 patients diagnosed with BPPV were included in the study. Of these, 38 patients (46.3%) experienced recurrence during follow-up, whereas 44 patients (53.7%) remained recurrence-free.

The recurrent group was significantly older than the non-recurrent group (54.1 ± 9.8 years vs. 45.5 ± 7.3 years, p <0.001). Females constituted 65.9% of the study population (54/82). Recurrence occurred in 31 of 54 females (57.4%) compared with 7 of 28 males (25.0%), indicating a significantly higher recurrence rate among women (p <0.01).

Mean serum 25-hydroxyvitamin D levels were significantly lower in patients with

recurrence than in those without recurrence (23.7 ± 7.1 ng/mL vs. 29.7 ± 6.0 ng/mL, p <0.001). Vitamin D status demonstrated a significant association with recurrence. Recurrence was observed in 9 of 12 patients (75.0%) with vitamin D deficiency, 21 of 29 patients (72.4%) with vitamin D insufficiency, and only 8 of 41 patients (19.5%) with sufficient vitamin D levels (p <0.001).

Comorbidities were assessed as secondary variables. Diabetes mellitus was significantly more common among recurrent patients than non-recurrent patients (50.0% vs. 13.6%, p = 0.001). Hypertension was also more frequent in recurrent patients (36.8% vs. 15.9%, p = 0.042). No significant association was observed for osteoporosis (p = 0.462), hypothyroidism (p = 0.594), or migraine (p = 1.000).

Multivariable logistic regression analysis including age, sex, and serum vitamin D level demonstrated a statistically significant model (Likelihood Ratio p <0.001; Nagelkerke $R^2 = 0.26$). Increasing age was independently associated with recurrence (aOR 1.10, 95% CI 1.03–1.17, p = 0.004), corresponding to an approximately 10% increase in recurrence odds per additional year of age. Higher serum vitamin D levels were independently protective against recurrence (aOR 0.91, 95% CI 0.84–0.99, p = 0.029), indicating an approximate 9% reduction in recurrence risk for every 1 ng/mL increase in vitamin D concentration. Female sex demonstrated a trend toward increased recurrence risk (aOR 3.22, 95% CI 0.94–11.08, p = 0.064) but did not achieve statistical significance after adjustment.

Overall, advancing age and lower serum vitamin D levels emerged as independent predictors of recurrent BPPV. Although female patients exhibited higher recurrence rates on univariate analysis, this association was attenuated after multivariable adjustment. Additionally, diabetes mellitus and hypertension were significantly associated with recurrence on univariate analysis, suggesting that metabolic and vascular comorbidities may contribute to recurrence risk and warrant further investigation in larger prospective studies.

DISCUSSION

The present study evaluated the relationship between serum vitamin D levels and recurrence of benign paroxysmal positional vertigo (BPPV) in 82 patients. Nearly half of the study population (46.3%) experienced recurrence during follow-up, highlighting the substantial burden of recurrent disease despite successful initial repositioning therapy. The relatively high recurrence rate observed in the present study may reflect the tertiary referral nature of the participating institutions and the inclusion of patients with complete follow-up records.

A significant finding of the present study was the association between lower serum vitamin D levels and BPPV recurrence. Patients with recurrent BPPV had significantly lower mean vitamin D levels than non-recurrent patients, and recurrence rates were markedly higher among individuals with vitamin D deficiency and insufficiency. Furthermore, multivariable logistic regression demonstrated that serum vitamin D level remained an independent predictor of recurrence after adjustment for age and sex. These findings are consistent with the growing body of evidence suggesting that disturbances in calcium metabolism contribute to otoconial degeneration and impaired otoconial repair mechanisms. Vitamin D plays a central role in calcium homeostasis, and deficiency may increase susceptibility to otoconia detachment within the utricle, thereby predisposing patients to recurrent episodes of BPPV.[9]

Several previous studies have reported similar observations. Jeong et al. demonstrated significantly lower vitamin D levels in patients with recurrent BPPV compared with controls and suggested that vitamin D deficiency may represent a modifiable risk factor for recurrence.[4] Talaat et al. further showed that correction of vitamin D deficiency reduced recurrence rates during follow-up, supporting a causal relationship between vitamin D status and vestibular outcomes.[9] More recently, a randomized controlled trial by Hong et al. reported a reduction in recurrent attacks among patients receiving vitamin D supplementation, reinforcing the importance of maintaining adequate vitamin D levels in susceptible individuals.[10]

Age was another important determinant of recurrence in the present study. Recurrent patients were significantly older than non-recurrent patients, and increasing age remained independently associated with recurrence on multivariable analysis. Age-related degeneration of otolithic structures, reduced regenerative capacity of vestibular sensory epithelium, and alterations in calcium metabolism may collectively contribute to the

higher recurrence rates observed among older individuals. Similar associations between advancing age and recurrent BPPV have been reported by De Stefano et al. and other investigators.[11]

Female patients exhibited a higher recurrence rate than male patients in the present study. Although this association did not retain statistical significance after adjustment, the observed trend is consistent with previous reports describing a greater prevalence of BPPV and recurrent disease among women. Hormonal influences, particularly postmenopausal changes affecting calcium metabolism and bone turnover, have been proposed as possible explanations.[12]

The present study also demonstrated significant univariate associations between recurrence and comorbid conditions such as diabetes mellitus and hypertension. These findings support the hypothesis that microvascular compromise and metabolic dysfunction may adversely affect inner ear homeostasis. However, these variables were not included as primary predictors in the final regression model because of sample size limitations. Larger studies are required to determine whether these comorbidities independently contribute to recurrence risk.[13]

The main limitations of this study include its retrospective design, relatively small sample size, and single-centre setting. Follow-up duration was not uniform for all patients, and potential confounding factors such as bone mineral density and long-term vitamin D supplementation history could not be fully evaluated. Despite these limitations, the study provides clinically relevant evidence supporting the role of vitamin D deficiency in recurrent BPPV.

In conclusion, lower serum vitamin D levels and advancing age were significantly associated with recurrent BPPV. These findings suggest that assessment and correction of vitamin D deficiency may represent a simple and potentially effective strategy for reducing recurrence in susceptible patients.

CONCLUSION

Findings from this study support the role of vitamin D in patients with BPPV. Multivariate analysis identified vitamin D deficiency as an independent predictor for recurrence and correction of Vitamin D deficiency may be beneficial in reducing BPPV recurrence. Being a retrospective analysis, the study has its limitations but the findings from this study are encouraging and further prospective studies with larger cohorts are warranted in future.

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