

Evaluation of Vitamin D Level in Patients with Vertigo

Mohamed El Shultamy , Hamza Bohurira , Hajar Farkash* , Huda El Atrash 

Department of ENT, Faculty of Medicine, University of Benghazi, Benghazi, Libya

Email: hajerfarkash@gmail.com

Abstract

From January 2023 to December 2023, a cross-sectional study was conducted in ENT clinics in Ajdabiya city, Libya, on 50 patients with vertigo. Growing evidence links vitamin D to vertigo, so this study evaluated vitamin D levels in patients with vertigo. Those who gave informed consent were invited to participate in the study. Inclusion criteria were patients older than 18 years of both sexes with vertigo. Patients aged less than 18 years, with co-morbidities, and non-Libyan patients were excluded. All patients underwent a detailed history, complete clinical examination, and vitamin D level estimation. Sixty per cent of the 50 participants had low vitamin D levels, with a median vitamin D level of 15.12 ng/ml. Patients with vertigo tend to have lower levels of vitamin D than normal individuals. Testing for vitamin D levels and supplementing when there is insufficiency in vertigo patients may reduce recurrence and improve quality of life.

Keywords: Vitamin D, Vertigo, Benign Paroxysmal Positional Vertigo (BPPV), Otoconia, Vestibular disorder.

Introduction

Vitamin D is a fat-soluble secosteroid hormone precursor that plays a fundamental role in calcium and phosphate homeostasis, skeletal mineralisation, and maintenance of bone health. Unlike most vitamins, vitamin D can be synthesised endogenously in the skin following exposure to ultraviolet-B (UVB) radiation and can also be obtained from dietary sources and supplements. Vitamin D is sequentially hydroxylated in the liver and kidneys to its biologically active form, calcitriol. Calcitriol exerts its effects through the vitamin D receptor (VDR), which is found in many tissues throughout the body. In addition to its well-known actions in bone metabolism, vitamin D has important effects on neuromuscular function, immune regulation, and the maintenance of calcium balance in the inner ear [1-5].

Benign paroxysmal positional vertigo (BPPV) is the most common peripheral vestibular disorder characterised by recurrent brief episodes of vertigo precipitated by changes in head position. The pathophysiology involves dislodgement of calcium carbonate otoconia from the utricle into the semicircular canals with subsequent abnormal stimulation of the vestibular receptors. Otoconia are mainly calcium carbonate crystals, and in consequence disturbance of calcium metabolism may be involved in degeneration, detachment and recurrence of BPPV [6-8]. There is increasing evidence that vitamin D deficiency may be an important risk factor for development and recurrence of BPPV. Several observational studies showed significantly lower serum 25-hydroxyvitamin D [25(OH) D] levels in patients with recurrent BPPV compared with healthy controls. Systematic reviews and meta-analyses have consistently reported the association between vitamin D deficiency and an increased risk of BPPV recurrence, suggesting that impaired calcium homeostasis may have a detrimental effect on otoconial integrity and vestibular function [9-13].

Recent interventional studies also showed that vitamin D supplementation, especially in vitamin D deficiency, significantly reduced the recurrence rate of BPPV. These findings are consistent with the hypothesis that an adequate vitamin D status contributes to normal vestibular physiology and may improve clinical outcomes in susceptible individuals. However, the strength of this association varies among populations, and further data from different geographical regions are still needed to clarify the association between vitamin D status and BPPV [10, 14-16]. Despite the increasing number of published studies, data regarding the association between serum vitamin D levels and BPPV remain limited in Middle Eastern and North African populations. Therefore, the present study was conducted to investigate the relationship between serum vitamin D levels and benign paroxysmal positional vertigo and to evaluate whether vitamin D deficiency may be associated with the occurrence of this common vestibular disorder.

Vertigo and benign paroxysmal positional vertigo

Vertigo is a common clinical symptom defined as a false sensation of movement, usually described as spinning or rotational dizziness, caused by dysfunction of the vestibular system. It represents a large proportion of neurology and otolaryngology consultations and has a major impact on patients' quality of life, affecting their balance, mobility and daily activities. Vertigo can be broadly divided into peripheral and central vertigo, depending on the underlying pathology. Peripheral vertigo is caused by pathology of the inner ear or vestibular nerve, whereas central vertigo is caused by disorders that involve the brainstem or cerebellum. Vertigo seen in clinical practice is mostly due to peripheral causes. Peripheral vertigo tends to have a better prognosis than central vertigo [17-20].

BPPV is the most common peripheral vestibular disorder and the most common cause of recurrent positional vertigo in adults. The disorder is characterised by short episodes of vertigo triggered by changes of posture in relation to gravity, such as turning over in bed, looking upwards or bending forward. Although BPPV is thought to be a benign condition, recurrent attacks can significantly increase the risk of falls, functional disability, anxiety, and lower quality of life, especially in older adults [17, 21, 22]. The pathophysiology of BPPV is primarily explained by displacement of otoconia from the utricular macula into one of the semicircular canals, most commonly the posterior canal. These free-floating calcium carbonate

particles (canalithiasis) or particles attached to the cupula (cupulolithiasis) produce inappropriate endolymphatic flow during head movements, resulting in abnormal stimulation of vestibular hair cells and the characteristic symptoms of vertigo and positional nystagmus. Age-related degeneration of otoconia, head trauma, vestibular neuritis, osteoporosis, and disorders affecting calcium metabolism have all been identified as important risk factors for BPPV [23-27]. Diagnosis of BPPV is mainly based on clinical history and positional tests, particularly the Dix–Hallpike manoeuvre for posterior canal involvement and the supine roll test for horizontal canal disease. Canalith repositioning procedures, especially the Epley manoeuvre, remain the first-line treatment and achieve symptom resolution in most patients. Nevertheless, recurrence is common, with reported recurrence rates ranging from 15% to 50% over several years. This high recurrence rate has prompted increasing interest in identifying modifiable risk factors, including vitamin D deficiency, that may contribute to the development and recurrence of BPPV [28-32]. This study aims to evaluate vitamin D levels in patients with vertigo in Ajdabiya city.

Materials And Methods

Technical design

Setting

This study was conducted at ENT clinics in Ajdabiya city.

Population or subjects

Patients presented to ENT clinics in Ajdabiya city with vertigo, and their status fulfilled the inclusion and exclusion criteria.

Inclusion criteria/exclusion criteria

Inclusion criteria: Age more than 18 years, both sexes, and all patients presented with vertigo.

Exclusion criteria: Age less than 18 years, comorbid patients, and non-Libyan patients.

Operational design

Process

Selected patients were subjected to the following:

- Full history taking including present complaint, history, and family history with stress on age, gender, duration, severity, aggravating and relieving factors, as well as symptoms such as nausea, vomiting, relation to head movement, tinnitus, or ear fullness.
- Complete clinical examination, either systemic or local ear examination for ear discharge and tympanic membrane changes (change in colour, mass, perforation, and granulation tissue).
- Vitamin D assessment.

Timeline

One year, from January 2023 to December 2023.

Obstacles/limitations of study

Uncooperative patients who refused to give consent to participate in the study.

Administrative design

- Approval was obtained from the managers of Ajdabiya Speciality Hospital.
- The work was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.
- Informed verbal consent was obtained from each participant.
- Confidentiality and personal privacy were respected at all levels of the study.
- Collected data were not used for any other purpose.

Statistical analysis

Data collected through history taking, clinical examination, laboratory investigations, and outcome measures were coded, entered, and analysed using Microsoft Excel. Data were then imported into the Statistical Package for the Social Sciences (SPSS, version 20.0) for analysis. Qualitative data were represented as numbers and percentages.

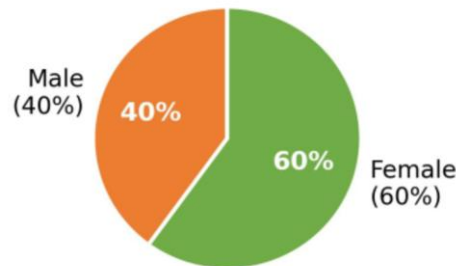
Results

Fifty participants were included in the study. As shown in (Table 1), 10% of participants were aged 18-30 years, 30% were aged 31-45 years, 40% were aged 46-60 years, and 20% were older than 60 years.

Table 1. Age distribution among participants.

Age (years)	Cases (n=50)	Percentage
18-30	5	10%
31-45	15	30%
46-60	20	40%
More than 60	10	20%
Total	50	100%

As shown in (Figure 1), 40% of participants were male, and 60% were female.

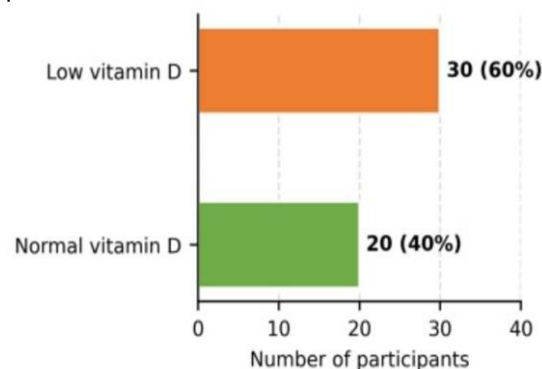
**Figure 1. Sex distribution of the study population.**

According to (Table 2), the distribution of participants regarding presenting complaint (nausea, vomiting, tinnitus, dizziness, and ear fullness) showed percentages of 50%, 30%, 4%, 10%, and 6%, respectively.

Table 2. Distribution of participants regarding their complaints.

Complaint	Participants (n=50)	Percentage
Nausea	25	50%
Vomiting	15	30%
Tinnitus	2	4%
Dizziness	5	10%
Ear fullness	3	6%
Total	50	100%

As shown in (Figure 2), 60% of participants had a low vitamin D level.

**Figure 2. Distribution of vitamin D level among participants.****Table 3. Value of vitamin D level (ng/ml) among participants.**

Normal vitamin D level (ng/ml)	Median vitamin D level among participants (ng/ml)
25-80	15.12

Discussion

Vitamin D (also referred to as calciferol) is a fat-soluble vitamin that is naturally present in a few foods, added to others, and available as a dietary supplement. It is also produced endogenously when ultraviolet (UV) rays from sunlight strike the skin and trigger vitamin D synthesis [15]. Enzymes belonging to the cytochrome P450 (CYP) superfamily are responsible for the metabolism of vitamin D3. Vitamin D3 is transformed into 25-hydroxycholecalciferol (calcidiol, 25-OHD3) in the liver. The more active metabolite 1,25-dihydroxycholecalciferol, commonly known as calcitriol or 1,25-(OH)2D3, is produced in the kidneys' proximal tubule cells from 25-hydroxycholecalciferol [5]. About 30 ng/mL of 25-hydroxycholecalciferol and 0.03

ng/mL (about 100 pmol/L) of 1,25-dihydroxycholecalciferol are the typical plasma levels. There does not seem to be strict regulation over the production of 25-hydroxycholecalciferol [1]. However, systemic Ca^{2+} and PO_4^{3-} control renal secretion of 1,25-dihydroxycholecalciferol, catalysed by 1 α -hydroxylase, in a feedback manner. It increases the synthesis of PTH. It increases PTH secretion at lower plasma Ca^{2+} concentrations.

The development and degeneration of otoconia are closely related to the calcium and 25-hydroxyvitamin D [25(OH) D] metabolism in the inner ear [2]. Otoconia are formed by deposition of calcium carbonate on a core of glycoprotein. The otoconia formation, development and degeneration stages are determined by the active calcium metabolism in the vestibular otolith organs [30]. It has been shown that vertigo in osteoporosis and osteopenia is due to disturbed Ca^{2+} metabolism. 25-hydroxyvitamin D modulates expression of some Ca^{2+} -binding proteins and receptors in the inner ear. The variation of acidic pH and Ca^{2+} concentration in the endolymph might lead to deformities and a reduction in size of the otoconia. Deficiency of vitamin D affecting calcium metabolism in the inner ear and causing vertigo has been suggested [32, 33]. Treating vitamin D deficiency has been shown to reduce recurrence and severity of the disease, and it has recently been suggested that people with vertigo should have their 25(OH)D levels assessed and be given vitamin D supplementation as required [13].

A prospective cross-sectional study in ENT clinics in the city of Ajdabiya from January 2023 to December 2023 on 50 patients with vertigo to assess vitamin D levels in patients with vertigo in the city of Ajdabiya. As per the demographic data in our study, 10% of the participants were in the age group 18–30 years, 30% of 31–45 years, 40% of 46–60 years and 20% of >60 years. 40% of the participants were male, and 60% were female. Dizziness occurs in all ages, but is more common in the elderly, which is consistent with our findings. In one study with 298 patients, the median age was 61 years, and 275 (92.3%) were >45 years of age [17]. Our results are in agreement with the findings of von Brevern et al. and Sarsithithum et al., who reported a higher prevalence and incidence rate of vertigo in females [11]. Von Brevern et al. performed a cross-sectional epidemiological study and showed a strong female preponderance among vertigo patients, and the prevalence of vertigo during the past year among patients older than 60 years was almost 7 times higher than that among patients aged between 18 and 39 years, which is in agreement with our results [24]. According to Schoor et al., the likely pathophysiology is that with increasing age, the decline of vestibular function is associated with degeneration in the number of neurons, vestibular hair cells, and otolith crystals [31]. Jang et al. performed an animal study on age-related changes in otoconial morphology and found weakening or breakage of junctional filaments and otoconial fragments in aged rats, the displacement of which could contribute to vertigo [23].

In addition, lower estradiol levels in menopausal and postmenopausal females might cause disturbance of endolymphatic calcium and interfere with internal otolith structure or their interconnections. The distribution of our participants according to the complaints (nausea, vomiting, tinnitus, dizziness and ear fullness) was 50%, 30%, 4%, 10% and 6%, respectively. Low vitamin D levels were observed in 60% of the participants, with a median of 15.12 ng/mL. Ren et al. found a low concentration of 25(OH)D and a high prevalence of vitamin D deficiency in patients with vertigo, similar to the results of our study [13]. Vitamin D deficiency is a worldwide health problem in all age groups. In a large-scale study of serum vitamin D status in the population of Beijing, Junyue et al. investigated 3,524 urban adults living in Beijing in 2019–2021, and found that the prevalence of vitamin D deficiency was 53.9%, which was lower than our results [32]. In addition, Yang et al. and Talaat et al. also indicated that vitamin D deficiency and extremely low vitamin D levels are involved in the aetiology and recurrence of vertigo [10, 12]. Another meta-analysis on the association of serum vitamin D and vertigo showed that vertigo patients, particularly with recurrent vertigo, had low serum vitamin D levels [10]. Additionally, Buki et al. reported that serum vitamin D concentrations were significantly lower in patients with vertigo recurrence than in those without recurrence [16]. Moreover, Buki et al. reported that serum vitamin D concentrations were significantly lower in patients with vertigo recurrence than in patients without vertigo recurrence [34].

Conclusion and Recommendations

This study concludes that patients suffering from vertigo are prone to lower vitamin D levels than normal individuals. Given the prevalence of vitamin D deficiency in the general population and the low risk of toxicity associated with vitamin D supplementation, it is reasonable to test vitamin D levels and consider supplementation in vertigo patients with insufficient vitamin D levels to reduce the incidence of recurrence and improve quality of life. In addition, further studies are needed to analyse all aspects of this issue.

Authors' contributions

Mohamed ElShultamy conceived and designed the study and supervised the overall research process. Hamza Fathi Bohurira contributed to patient recruitment and clinical examination of participants. Hajar Farkash contributed to data collection and coordination of the vitamin D level assessments. Huda Gadri El Atrash performed data entry and statistical analysis and drafted the initial manuscript. All authors critically revised the manuscript for important intellectual content, approved the final version to be published, and agree to be accountable for all aspects of the work.

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Conflict of Interest

Mohamed El Shultamy, Hamza Fathi Bohurira, Hajar Farkash, and Huda Gadri El Atrash declare that they have no conflicts of interest.

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