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Vitamin D deficiency and benign paroxysmal positioning vertigo

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Abstract

Benign paroxysmal positional vertigo is a common cause of disabling vertigo with a high rate of recurrence. Although connections between vitamin D deficiency and osteoporosis, as well as between osteoporosis and benign paroxysmal positional vertigo have been suggested respectively in the literature, we are not aware of any publication linking vitamin D and benign paroxysmal positional vertigo. As a hypothesis, we suggest that there is a relation between insufficient vitamin D level and benign paroxysmal positional vertigo. In order to test this hypothesis, in a small retrospective pilot study, 25-hydroxyvitamin D levels in serum of patients with benign paroxysmal positional vertigo and frequency of recurrence after correction of serum level were assessed retrospectively. Patients with idiopathic positional vertigo had a low average serum level of 25-hydroxyvitamin D (23 ng/mL) similar to that of the general Austrian population, which has a high prevalence of hypovitaminosis D. In 4 cases with chronically recurrent severe vertigo episodes, average levels of serum 25-hydroxyvitamin D were even significantly lower than in the other vertigo patients, who had their first episode. Vertigo attacks did not recur after supplementation with vitamin D.

We raise the possibility that patients with benign paroxysmal positional vertigo who have low vitamin D levels may benefit from supplementation and suggest further epidemiological investigations to determine the effect of correcting vitamin D deficiency on the recurrence of vertigo. Given the many known benefits of vitamin D, the authors recommend the measurement of vitamin D in patients with benign paroxysmal positional vertigo and supplementation if necessary.

Keywords

Vitamin D; Deficiency; paroxysmal positional vertigo

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Introduction

BPPV is a common disorder

Benign paroxysmal positional vertigo (BPPV) is the most common neuro-otological disorder [1]. Today it is accepted, that it is caused by dislodged otoconia, which fall from the utricular macula and float into the semicircular canals thereby making them sensitive to gravity [2]. Otoconia crystals have distinct central cores and peripheral zones (for review see [3]). The core is predominantly organic with a lower level of Ca^{2+} , and the periphery is largely inorganic with a higher level of Ca^{2+} [4]. The core, periphery and external surface of the crystals all have inter-connecting fibrous material with varied diameters and organization. The main inorganic mineral component is almost exclusively a polymorph of calcium carbonate (CaCO_3). The organic component is usually a predominant glycoprotein. Otoconia crystals are partially embedded in a membranous/fibrous matrix and are tethered by proteinaceous filaments to the kinocilium of the underlying hair cells. The formation of otoconia surrounded by low-calcium endolymph is a tightly controlled active process [3].

It has been shown that elderly people may suffer from unrecognized, chronic BPPV. In 2000 a widely cited cross-sectional study was published, which determined the prevalence of unrecognized benign paroxysmal positional vertigo (BPPV) in an inner-city geriatric population [5]. Dizziness was found in 61% of patients. Nine percent were found to have unrecognized BPPV. Patients with unrecognized BPPV were more likely to have reduced activities of daily living scores, to have sustained a fall in the previous 3 months, and to have depression. These data indicated that unrecognized BPPV is common within the elderly population and has associated morbidity. Apart from classical BPPV with nystagmus chronic subjective BPPV without nystagmus may also be common, recently a mechanism for that has been suggested [6].

Osteoporosis and BPPV

Back in 2003 Vibert et al suggested a connection between BPPV, osteoporosis and osteopenia [7]. Since then another independent group also showed that bone metabolism has a connection to BPPV [8]. Recent studies in Dr. Lundberg's laboratory show common features between bone and otoconia biomineralization. For example, the organization of the matrix is similar between the two tissues, and most of the protein constituents are present in both tissues. Similar to that in bone and teeth, biomineralization in otoconia involves tight regulation of the formation of an organic matrix at specific sites and the deposition of mineral crystallites in an ordered manner [9–11, Lundberg, unpublished data]. In animal experiments it has been shown that this process is dysfunctional in osteoporosis [12]. Even a beneficial therapeutic effect could be observed between BPPV and osteoporosis when treated with bisphosphonates in women [13].

Osteoporosis and Vitamin D

The effect of vitamin D on osteoporosis has been established in the literature (for review see [14]). Calcium and vitamin D play important roles in improving bone mineral density and reducing the risk of fracture [15]. It is also known that vitamin D supplementation reduces

the risks of falls and fractures in elderly people [16]. According to these authors this may be due to the effect of vitamin D by improving neuromuscular function.

The hypothesis – Vitamin D and BPPV

Although connections between vitamin D and improved osteoporosis, as well as between osteoporosis and BPPV have been suggested respectively in the literature, we are not aware of any publication linking vitamin D and BPPV. As a hypothesis we suggest, that there is a relation between vitamin D and BPPV. Therefore, we recommend to measure 25(OH)D in BPPV patients and to supplement it, if there is a deficiency.

If there is a connection between BPPV and vitamin D, it may also be possible that the beneficial effect of Vitamin D on reduction of falls in BPPV is perhaps aided by decreasing recurrence of chronic BPPV.

Pilot study

To establish, if in our records any evidence for such a connection can be gathered, we retrospectively analysed laboratory records to decide if patients with BPPV had low 25-hydroxyvitamin D (25(OH)D levels and if so, correcting serum levels showed a beneficial effect in patients with BPPV.

Patients, methods

We analysed the records of 18 consecutive patients suffering from BPPV who were examined at the vertigo/dizziness ambulance at Krems General Hospital, Austria between 01st May and 1st August 2011. Inclusion criteria were: 1. Diagnosis of canalolithiasis or cupulolithiasis either of vertical canals or of the horizontal canal established by typical positional nystagmus [2]; 2. Availability of the results of follow up examination; 3. Availability of actual 25(OH)D value in the serum at the first visit or at the follow up examination; 4. Negative radiological results (MRI of cerebrum); 5. Negative neurological status; 6. Successful repositioning maneuver at the first visit; 7. Symmetric hearing thresholds

The group of patients included 11 females and 7 males (average age = 67 years (min: 45; max: 85 years). After documenting history of complaints the routine neurootological examination was carried out including positional testing as described elsewhere [6]. 25(OH)D was measured by Elecsys® Vitamin D3 (cobas®), an electrochemiluminescence immunoassay on a combined chemistry and immunoassay platform standardised against the liquid chromatography-tandem mass spectrometry reference method.

During a follow up examination the neurootological examination was repeated and in cases with low serum level of 25(OH)D and no history of nephrolithiasis, supplementation started. If the level of 25(OH)D was under 20 ng/mL, then the supplementation consisted of daily 8000 IU cholecalciferol for two weeks, and daily 4000 IU cholecalciferol for the next two weeks, then a weekly dose of 8000 IU was given as recommended in [17]. Shortest follow up was 8 month. After this time the patients were contacted on the phone and, in an interview, their eventual complaints were assessed.

Statistics

We carried out a nonparametric (no normal distribution) two-tailed Mann Whitney test, to test significant difference between the two groups.

Results

At the first examination in all cases posterior canalolithiasis could be demonstrated (11 on the right, 7 on the left side). It was possible to carry out a successful repositioning (Epley-maneuver [18] in every case.

History of complaints

In one case the patient had had vestibular neuritis 3 weeks before the BPPV episode on the same side as the BPPV (in this case the 25(OH)D level was normal). In 14 cases (Group A) the patients had their first episode of BPPV, in average since 12 days (min: 4 days, max: 60 days). In four cases (Group B) the patients had been having multiple episodes over several years. The data of these patients are shown in Table 1.

Average 25(OH)D level in all patients (Group A+ Group B) was 23 ng/mL (minimum:11, 25% percentile: 15; median 17; 75% percentile 33; maximum 51). In 10 cases the 25(OH)D level was under 20 ng/mL (an “insufficient” 25(OH)D level [19] and clearly under the recommendation of [17]).

After having examined all BPPV patients we divided the group of all patients into two groups. Group A: first manifestation, Group 2: recurrent BPPV. In Group A average serum 25(OH)D level was 27 ng/mL (minimum:13, 25% percentile: 16; median 24; 75% percentile 37; maximum 51). In Group B average serum 25(OH)D level was 14 ng/mL (minimum:11, 25% percentile: 12; median 14; 75% percentile 15; maximum 15). The difference between the two groups was significant (Mann Whitney test; $p < 0.02$). We show the data distribution in Fig. 2.

Follow up evaluation

At the time of the first follow up examination nystagmus due to BPPV could not be demonstrated in any cases. Until the time of the telephone interview there was no recurrence of the BPPV complaints in any of the groups.

Consequences of the hypothesis and discussion

We found that our patients with idiopathic BPPV had low average vitamin D serum levels (23 ng/mL). This is similar to that of the general Austrian population (in average 20.9 mg/mL [20]), which has a high prevalence of vitamin D hypovitaminosis. We identified 4 patients, who had been having recurrent episodes of BPPV for a longer time before the examination with a frequency of 4–6 relapses/year for several years. These patients as a subgroup had significantly lower average serum level of 25(OH)D than patients in the subgroup in which with a first episode. After having been supplemented with vitamin D, BPPV patients have not encountered relapses in the follow up period of at least 8 month.

Although some BPPV cases are benign, most cases recur. In a recent study the recurrence rate of BPPV was 27%, and relapse largely occurred in the first 6 months ([21]). At present, the generally accepted recurrence rate of BPPV after successful treatment is 40 to 50% at 5 years of average follow up. A subset of individuals appears prone to multiple recurrences [21, 22]. In our study in 4 cases with chronically recurrent severe BPPV episodes low levels of serum 25(OH)D could be measured, and, BPPV did not recur after supplementation with Vitamin D.

These preliminary results show that a hypothesis linking vitamin D and BPPV may be valid. Although we cannot rule out coincidence at the present, given the multiple benefits of vitamin D, we recommend supplementation in BPPV cases.

The so-called classical effects of vitamin D are that on bone density, bone quality and muscle performance. In this context, it is listed among the classical effects that falling of elderly people was significantly reduced in vitamin D supplemented individuals compared to those receiving calcium and placebo [23, 24].

Theoretically it may even be possible that supplementation with vitamin D brings about a decrease of falls through decreasing the frequency of unrecognized BPPV. Even if this not the case, it is easy to see that perhaps a synergistic relationship may be influenced by correcting abnormally low vitamin D levels. In the literature the possibility of numerous other, so-called non-classical effects also have been described (cardiovascular, diabetes mellitus, cancer, multiple sclerosis, allergy, asthma (see Review[19]). These authors also classified vitamin D status according to measured 25(OH)D concentration: less than 10 ng/mL: deficient; between 11–20: insufficient; higher than 20 ng/ml: optimal. Recently an international panel reached agreement about the need for vitamin D supplementation in specific groups of patients in these clinical areas and the need for assessing their 25-hydroxyvitamin D (25(OH)D) serum levels for optimal clinical care. A target range of at least 30 to 40 ng/mL was recommended ([17]). The mechanism of the beneficial effect of vitamin D may involve improvement of pathologic biomineralization of otoconia similar to that of bone and teeth.

We decided to publish our hypothesis because of the following reasons:

- According to theoretical considerations the existence of a link between otolithic disturbances and vitamin D deficiency is highly probable
- Given the prevalence of vitamin D deficiency and the simplicity of the procedure (measurement of vitamin D levels and supplementation if necessary) the recommended correction should be done anyway
- BPPV is so common, that even if the supplementation of vitamin D inhibits recurrence only in a small percentage of cases, this means a large number of cases with improvement

We suggest further statistical epidemiological investigations to determine average serum levels of 25(OH)D in patients with BPPV and the effect of correcting vitamin D deficiency on the recurrence of BPPV. Even until these results are available, given the other known

benefits of vitamin D, we recommend measurement of 25(OH)D and supplementation if necessary.

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Figure 1.

Our hypothesis establishes connection between vitamin D and BPPV. The arrows show the connections established in the literature so far, the question mark designates the hypothetical connection

Figure 2.
Column statistics of 25(OH)D serum levels in Group A and B (individual values and mean $\pm$ 95% confidence interval are shown)

Table 1

Data and 25(OH)D levels of four patients with severe recurrent BPPV

Patient number	Sex	Age	25(OH)D (ng/mL)	History of complaints (since when)
14	f	64	11	recurrent episodes since 2 years; sum of episodes 8; each episode for weeks
15	f	45	16	recurrent episodes since 4 years, sum of episodes : 10; each episode for weeks
16	f	72	13	episodes 10 years ago, then 5 years ago, since 2 years approx. every second month; sum of episodes 13; each episode for days
18	f	53	15	since 2 years every third months; sum of episodes: 5; each episode for weeks