A rationale for vitamin D prescribing in a falls clinic population

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Abstract

Objective: to assess the prevalence of vitamin D insufficiency in a falls clinic population. To identify simple clinical predictors of vitamin D insufficiency.

Design: prospective observational descriptive study.

Participants: 400 consecutive patients who attended a falls clinic taking referrals from a casualty department or general practitioners.

Results: Hypovitaminosis D is very common, affecting at least 72% of a falls clinic population. The number of times an individual goes out per week and serum albumin are independent predictors of hypovitaminosis D, but the predictive value is low.

Conclusions: the prevalence of vitamin D insufficiency is high in a falls clinic population. It is difficult to predict which individuals are most at risk within this population. The benefits of vitamin D supplementation in older people are well recognized. Therefore in the absence of toxic effects, a pragmatic approach may be to supplement all attendees at a falls clinic.

Keywords: falls, ageing, vitamin D

Introduction

The recently published National Service Framework (NSF) for Older People has highlighted falls prevention and the effective treatment and rehabilitation of those who have fallen as important areas to be addressed [1]. The most common serious injury related to falls in the older population is hip fracture resulting in significant morbidity, mortality and financial burden. As part of an integrated and comprehensive falls assessment it is therefore important to identify and treat risk factors for both falls and hip fracture.

Vitamin D insufficiency is common, affecting up to 40% of community dwelling older people and is frequently unrecognized [2]. It may contribute to fracture risk via different mechanisms. The most well recognized mechanism is mediated via the effects on bone, causing increased parathyroid hormone secretion (PTH) and increased bone turnover, resulting in osteoporosis and osteomalacia [3]. An additional mechanism has been identified more recently. Vitamin D insufficiency impairs neuromuscular function by increasing postural sway [4], causing proximal myopathy [5] and affecting psychomotor function [6]. This may predispose to an increased risk of falls and thereby fractures.

Of the many treatments available for osteoporosis, supplementation with vitamin D and calcium has been shown to reduce the incidence of non-vertebral fractures in both institutionalized and community dwelling older people [7, 8]. It has also been shown to reduce postural sway and possibly the incidence of falls [4].

The NSF suggests that the identification of patients who may be deficient in vitamin D should be a priority and that all patients attending a falls clinic should receive advice with regards to calcium and vitamin D intake [1].
However, at present, identification of patients at risk of insufficiency relies on a blood test, which is expensive and may be unnecessary if individuals could be identified on the basis of clinical predictors.

In order to develop a rationale for vitamin D prescription for a falls clinic population, we examined the prevalence and predictors of vitamin D insufficiency in a prospective observational study of 400 consecutive patients attending a falls clinic.

**Aims**

To assess the prevalence of vitamin D insufficiency in a falls clinic population.

To identify simple clinical predictors of vitamin D insufficiency.

**Methods**

**Study design**

Prospective, observational descriptive study.

**The falls clinic**

The falls clinic based in South East London takes referrals from both King's College Hospital A&E department and from local general practitioners. All patients who attend have fallen at least once in the 8 weeks preceding the appointment and are aged 65 years and over.

**Subject description**

Data were collected for 400 consecutive patients attending the clinic using a pre-existing proforma [9]. This recorded demographic data, a complete medical history and social history including the number of times the patient went outdoors per week. Comorbidity was defined as the number of concomitant diseases identified from a list of common conditions (list available from authors). An abbreviated mental test (AMT) score was recorded and full physical examination performed. Body mass index (BMI) was calculated using the formula weight/height² (kg·m⁻²). Patients taking vitamin D and/or calcium supplements were excluded.

**Laboratory analyses**

Serum 25OHHD was measured using an IDS Gamma-B 25-OH immunoassay with I¹²⁵ 25-OH vitamin D label and a highly specific sheep anti-25-OH polyclonal antibody (IDS, Tyne & Wear, UK). This metabolite is the major stable circulating form and provides an integrated assessment of vitamin D intake and stores. Calcium, phosphate, alkaline phosphatase and albumin were measured by standard automated chemistries on DAX (Bayer, UK). Corrected calcium was calculated using the formula, Corrected calcium = serum calcium + [0.02×(40–serum albumin)]. Coefficients of variation were less than 5% throughout the study period.

**Definition of vitamin D insufficiency**

Patients were stratified into 4 groups depending on 25OHHD levels, those with 25OHHD < 12.0 µg/L (group 1), those with 25OHHD 12.1–20.0 µg/L (group 2), those with 25OHHD 20.1–40.0 µg/L (group 3) and those with 25OHHD > 40.1 µg/L (group 4). These levels were chosen for stratification as 12 µg/L is frequently quoted as the threshold for vitamin D deficiency [10]. There is evidence that a physiological response in terms of PTH rise occurs at <20 µg/L, this is important in terms of subclinical end organ effects [11]. Clinical studies suggest that in order to be replete and to reduce the risk of fracture, adults should maintain 25OHHD > 40 µg/L [11].

**Statistical analyses**

Data were analysed by a Stata Intercooled computer package (Timberlake, London, UK). Results with P values < 0.05 were considered statistically significant. Comparisons between groups were made using unpaired t-test and ANOVA. Chi² test was used for categorical variables. Multivariate analysis was used to determine independent variables for vitamin D status. Results are expressed as means with standard deviations.

**Results**

**Data collection**

Data were collected prospectively on all patients (n=400) attending the falls clinic between April 1999 and January 2001. Vitamin D results were not available on 26 patients. Results were analysed on 374 patients.

**Demographic characteristics of a falls clinic population**

Patients were elderly with a mean age of 78.3 (range 65–97). The majority were female (73.3%), lived in their own homes (96.0%) and were cognitively intact (90% AMT > 8/10). Seventeen percent of the total falls clinic population were housebound. A minority was of Afro-Caribbean background (8.3%). Mean BMI was 26.0 kg m⁻².
Vitamin D status of patients attending the falls clinic

The prevalence of vitamin D deficiency according to the stratification values chosen, is shown in Figure 1. Hypovitaminosis D was demonstrated in 72.5% of the population (25OHD < 20 µg/L). Of the total falls clinic population, 31.8% had severe hypovitaminosis D (<12 µg/L) and 40.6% had moderate hypovitaminosis. It was noted that only 1.3% of the population had 25OHD levels greater than 40 µg/L. Since this number was small, group 3 and 4 were amalgamated when comparing characteristics between the groups. The mean (SD) serum 25OHD for all falls clinic patients was 16.5 µg/L (7, 8).

The relationship between vitamin D levels and clinical parameters

Univariate analysis demonstrated that the number of times an individual goes out per week was significantly associated with 25OHD level (regression coefficient = 0.168, P = 0.002). Furthermore, 76% of the housebound had vitamin D < 20 µg/L (n = 78) versus 20.7% of those who went out every day (n = 85). All individuals in institutionalized care had vitamin D insufficiency although the total number was small (n = 14) (Table 1).

The number of patients of Afro Caribbean and Asian origin attending the falls clinic was small. However of those who did attend, a large proportion of the black population (90%, n = 47) had 25OHD < 20 µg/L, whereas in the Caucasian population this was 72% (n = 327). These differences were not statistically significant.

Using univariate analysis vitamin D status did not correlate with the number of comorbid conditions, number of drugs, AMT, BMI, number of previous fractures or smoking status within this population.

Table 1. Clinical characteristics of falls clinic population according to vitamin D status

<table>
<thead>
<tr>
<th></th>
<th>25OHD &lt; 12 µg/L</th>
<th>25OHD 12.1–20.0 µg/L</th>
<th>25OHD &gt; 20.1 µg/L</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 119</td>
<td>n = 152</td>
<td>n = 103</td>
<td></td>
</tr>
<tr>
<td>Mean Age</td>
<td>79.2 (7.5)</td>
<td>77.6 (7.2)</td>
<td>78.3 (6.6)</td>
<td>0.18 (ANOVA)</td>
</tr>
<tr>
<td>Mean BMI</td>
<td>26.3 (5.4)</td>
<td>26.7 (5.0)</td>
<td>25.0 (5.1)</td>
<td>0.06 (ANOVA)</td>
</tr>
<tr>
<td>Mean AMT</td>
<td>8.6 (1.9)</td>
<td>9.1 (1.6)</td>
<td>9.0 (1.4)</td>
<td>0.12 (ANOVA)</td>
</tr>
<tr>
<td>Mean no. of comorbid conditions</td>
<td>2.3 (1.4)</td>
<td>2.1 (1.3)</td>
<td>2.2 (1.3)</td>
<td>0.56 (ANOVA)</td>
</tr>
<tr>
<td>Mean no. of drugs</td>
<td>2.9 (2.4)</td>
<td>2.7 (2.2)</td>
<td>2.9 (2.0)</td>
<td>0.66 (ANOVA)</td>
</tr>
<tr>
<td>Mean no. of times out per week</td>
<td>2.9 (2.6)</td>
<td>4.1 (2.2)</td>
<td>4.0 (2.6)</td>
<td>0.0002 (ANOVA)</td>
</tr>
<tr>
<td>% of patients with previous fracture</td>
<td>27.9%</td>
<td>31.8%</td>
<td>22.6%</td>
<td>0.19 (ANOVA)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td>0.89 (X²)</td>
</tr>
<tr>
<td>Men</td>
<td>26.1%</td>
<td>27.7%</td>
<td>25.8%</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>73.9%</td>
<td>72.3%</td>
<td>74.2%</td>
<td></td>
</tr>
<tr>
<td>Ethnic origin</td>
<td></td>
<td></td>
<td></td>
<td>0.03 (X²)</td>
</tr>
<tr>
<td>White</td>
<td>86.5%</td>
<td>91.9%</td>
<td>96.7%</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>12.6%</td>
<td>8.1%</td>
<td>3.3%</td>
<td></td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
<td>0.04 (X²)</td>
</tr>
<tr>
<td>Own home</td>
<td>92.8%</td>
<td>96.6%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>7.2%</td>
<td>3.4%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Vitamin D levels in a falls clinic population.

The relationship between vitamin D levels and biochemical parameters

Serum bone biochemistry was normal in all patients. Serum albumin (coefficient = 0.113, P = 0.03) was directly associated with 25OHD status. However there was no association between 25OHD, and serum phosphate, corrected calcium, or alkaline phosphatase. Data regarding PTH status was not available as only routine blood tests were taken for these patients.

Independent predictors of hypovitaminosis D

By stepwise regression analysis, of all the variables tested (both clinical and biochemical), number of times out per week (coefficient = 0.40, P < 0.05) and albumin (coefficient = 0.29, P < 0.02) were the only independent variables for vitamin D status, accounting for 6% of variance in vitamin D concentrations. We were unable to identify a particular cut off for the number of times outdoors or serum albumin below which the risk of vitamin D deficiency increased.

Discussion

This is the first study examining the prevalence and predictors of vitamin D insufficiency in a falls clinic.
population, a population which is particularly at risk of fracture. We identified 72% of our falls clinic population to have vitamin D insufficiency (25OHD < 20 μg/L).

It is clear that the definition of vitamin D insufficiency may affect its prevalence and this is complicated by recent studies suggesting that the threshold for vitamin D insufficiency has been set too low in the past [12]. Previously it was thought that vitamin D deficiency had clinical impact only once levels were low enough to cause deranged bone biochemistry. However, many patients with normal bone biochemistry may have osteoporosis and/or osteomalacia on histology [13]. It is therefore considered important to identify and/or treat individuals with vitamin D insufficiency (subclinical vitamin D deficiency) particularly in a population already at risk of fracture by virtue of their falls.

Numerous studies demonstrate that physiological responses to vitamin D insufficiency occur once levels fall below 20 μg/L. Below these levels secondary hyperparathyroidism results, which in turn causes increased bone turnover and reduced bone mineral density [11]. Therefore, it is desirable to have levels of 25OHD greater than 20 μg/L (50 nmol/L). Moreover, clinical studies of vitamin D and calcium supplementation demonstrate that the rate of non vertebral fracture is reduced by achieving 25OHD levels greater than 42 μg/L (105 nmol/L) [7, 8]. In view of this, the desirable level of vitamin D particularly in high-risk groups such as elderly people who fall may be raised to 40 μg/L (100 nmol/L).

Using 20 μg/L as the cut off level we found 72% of patients to be deficient in vitamin D, however using a level of 40 μg/L our results would suggest that 98,7% of the falls clinic population are not vitamin D replete.

We did not observe any differences in bone biochemistry (calcium, phosphate, or alkaline phosphatase) between the three groups. This supports evidence that vitamin D insufficiency may exist in the absence of biochemical evidence of osteomalacia, and that these measurements cannot be used as markers of vitamin D insufficiency.

We found that the number of times that a patient goes outdoors per week was independently associated with vitamin D levels. This is not surprising since exposure to UV light accounts for the majority of vitamin D production [14]. It was also expected that those of a black background and those residing in homes would be more likely to have low vitamin D levels. Although this was observed, our study demonstrates that not only these populations are at risk of vitamin D insufficiency.

Although independent predictors for vitamin D status were identified (outdoor activity and albumin), they did not have a high predictive value for vitamin D insufficiency. It is therefore not possible to use these measures as surrogate markers. Thomas et al. examined hypovitaminosis D amongst general medical in-patients, with mean age of 62 years, and was also unable to find any reliable clinical predictors for vitamin D insufficiency [15].

Vitamin D supplements may be given orally (non proprietary preparation costs £9.00 per annum) or as an intramuscular injection of 300 000 iu ergocalciferol every 6 months [16] (non proprietary preparation £9.13 per annum). In contrast the blood test is extremely time consuming (2–3 weeks in specialist laboratories) and expensive at £25 per assay.

Concern over toxicity of vitamin D supplements has led to a reluctance to prescribe vitamin D supplements without first conducting a blood test. However evidence demonstrates that toxicity occurs only at serum levels above 80 μg/L. Doses of 40 000 iu per day are required to achieve these levels whereas treatment doses are of the order of 800 iu per day and do not result in toxic levels [12]. Therapeutic doses of vitamin D may however result in unmasking of primary hyperparathyroidism, and for this reason corrected calcium should be measured before and after initiating treatment.

Conclusion

Calcium and vitamin D supplementation has been established as a useful means of fracture prevention in older people. Whilst simple questioning can be useful in identifying an individual’s calcium intake and their need for calcium supplementation, we have shown that clinical and biochemical pointers are unreliable as predictors of vitamin D status. The overall prevalence of vitamin D insufficiency in a falls clinic population is very high and vitamin D supplementation is cheap. We pragmatically suggest that all individuals aged over 65 years attending a falls clinic should be offered vitamin D supplements unless the baseline serum calcium is elevated, or they are known to suffer from conditions such as a primary hyperparathyroidism, myeloma, metastatic malignancy or sarcoidosis.

Key points

- Vitamin D insufficiency is an important contributor to fracture risk and vitamin D supplements reduce non-vertebral fracture rate.
- Vitamin D supplements improve postural sway and may reduce falls.
- In an unselected falls clinic population 72% of patients have vitamin D insufficiency.
- There are no reliable predictors for vitamin D insufficiency in this population.
- A pragmatic approach may be to supplement all falls clinic attendees with vitamin D.
- There was no research funding or any conflict of interest.
References


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