Journal of Aging Research & Clinical Practice©
Volume 2, Number 3, 2013

INFLUENCE OF BARTHEL INDEX ON PLASMATIC LEVELS OF 25 HYDROXYVITAMIN D IN ELDERLY PATIENTS

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Abstract: *Objectives:* To evaluate the prevalence of vitamin D deficiency in the elderly and its relationship with the functional capacity. *Design:* Observational study. *Setting:* Emergency Department of a tertiary hospital. *Participants:* Consecutive non-selected patient's aged 65 or more. *Methods:* The patients were divided in two groups: moderate to severe disability (BI 0–75), and mild to no impairment (BI 76–100). Comparisons of vitamin D metabolites and parathormone between groups were made. *Measurements:* Barthel index, vitamin D metabolites and intact parathormone. *Results:* Fifty-nine patients were included. Mean age: 77.25 (8.5) years. Fourteen patients (23.7%) had a BI ≤ of 75. The patients with BI ≤ 75 had lower levels of 25 hydroxyvitamin D and 1,25 dihydroxyvitamin D compared with the BI > 75 group [(8.93 (3.4) vs 16.56 (12.5) ng/ml; p = 0.015), and (24.39 (12.8) vs 39.65 (21.1) pg/ml; p = 0.009], and higher levels of intact parathormone (113.29 (75.8) vs (64.59 (37.2) pg/ml; p = 0.020). Levels of 25 hydroxyvitamin D < 10 ng/ml was found in 71.4% of patients with BI ≤ 75 and in 44.4% with IB > 75. The only factor that predicted values of 25 hydroxyvitamin D below to 10 was a BI ≤ 75 (OR: 4.58; IC 95%: 1.124-18.689; p = 0.034). *Conclusions:* The prevalence of hypovitaminosis D in elderly is elevated. Patients with IB < 75 have lower levels of 25 hydroxyvitamin D. A BI below 75 predicts values of vitamin D less than 10ng/ml.

Key words: : Elderly patients, vitamin D, Barthel index, vitamin D deficiency.

Introduction

Vitamin D and its metabolites represent a group of steroid compounds that intervene in the regulation of phosphocalcic metabolism therefore being in close relation to the bone. The vitamin D deficiency leads to osteomalacia in adults and rickets in children and has also been postulated as a cause of involutional osteoporosis (OP) (1), in which bone loss occurs at a slower rate than in post-menopausal OP. The physiopathological mechanism of vitamin D deficiency in its initial stages appears to be caused by a diminished calcium intestinal absorption leading to secondary hyperparathyroidism which in turn enhances bone loss and consequently a higher risk of fractures (2).

Vitamin D deficiency has a high prevalence and represents a growing concern. This can be partly attributed to the physical limitation that the elderly patients have and to the lack of mobilization and sedentarism that derives from it, therefore spending most of their time indoors. The Barthel Index (BI) score is recommended in assessing functional status in elderly patients' (3). The objective of this study was to evaluate the prevalence of vitamin D deficiency in patients of 65 years or more from our hospital and also its relationship with the functional capacity measured with BI.

Methods

An observational study was carried out in consecutive non-selected patients aged 65 or more who were admitted for medical conditions in to the Emergency Department of Hospital del Mar, Barcelona, Spain. The duration of the recruitment period was two years. The Inclusion criteria for this study were any patient admitted to the emergency room for medical illness with age of 65 or older. Patients admitted for gynaecological, surgical or trauma conditions were excluded. No other exclusion criteria were made. The study was approved by the institutional review board and all participants or legal tutors gave written informed consent.

A simple questionnaire was used to collect anthropometric data, nutritional habits, including

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Received January 29, 2013
Accepted for publication March 20, 2013

calcium intake, use of coffee (three or more coffee daily) and alcohol (greater than 60 g of ethanol per day), physical activity and sun exposure, which was assessed on a semi quantitative scale. We also collected data like place of residence (domicile or nursing home), age of menarche and of menopause in women, if they were receiving oral calcium and vitamin D supplements, the usual treatment they were on, if they had had any conditions that could influence the mineral and bone metabolism, family history of osteoporosis, previous diagnosis of osteoporosis, previous fractures and if they were on any treatment for osteoporosis. The BI was used to determine the patient´s functional capacity prior to admission. The BI uses a scale of 0–100 to rate the degree of independence in daily activities, where 0 is total dependence, and 100 is total independence. There are three categories of functional impairment using the following cut-off values: severe (0–50), moderate (51–75), and mild to no impairment (76–100). BI was obtained from standardised interviews with patients and surrogate respondents in some cases. This scale and cut-off values had already been used previously (4).

Fasting blood samples were collected. Plasma calcium, phosphorus, and magnesium levels were measured by an auto analyzer (Olympus AU 510, Merck, Madrid, Spain). Plasma calcium and magnesium concentrations were determined by complexometric assay and serum phosphorus by direct colorimetric assay. Plasma hormone assays were measured by radioimmunoassay for 25-hydroxyvitamin D3 (25 D) and 1,25-dihydroxyvitamin D3 (1,25 D) (INCSTAR, DiaSORIN, Madrid, Spain), and by chemiluminescence immunoassay for intact parathyroid hormone (iPTH), (IMMULITE-ONE, DPC-DIPESA, Madrid, Spain).

The patients were divided in two groups: patients with moderate to severe disability (BI 0–75), and patients with mild to no impairment (BI 76–100). According recommendations we defined vitamin D deficiency for plasma levels of 25 hydroxyvitamin D of less than 10 ng/ml (5).

The statistical study was carried out using the SPSS 13.0. Comparisons between groups were made using the Student's t test or the Mann-Whitney U test. For categorical data the chi-square ($\chi 2$) test or the Fisher's exact test were used. The results were expressed as mean (SD) and percentage. A Spearman correlation was used to identify the relation between 25 hydroxyvitamin D and intact parathormone levels. Variables with significant difference in the univariate analysis were introduced in the multivariate logistic regression for identification of factors associated independent with vitamin D deficiency. The strength of association of the predictors was expressed as the odds ratio (OR) and as 95% confidence interval (CI). Values of $p<0.05$ were considered significant.

Results

The study population consisted of 59 patients out of whom 15 were male and 44 were female. The mean age was 77.25 (8.5) years. Fourteen patients (23.7%) had a BI ≤ of 75 and 45 (76.3%) a BI > of 75. The patients with a BI ≤ 75 had a superior mean age than the group with BI > 75 (81.20 (5.7) vs 76.00 (8.9) years; p = 0.013) and they had less active sun exposure (21.4% vs 51.1%; p = 0.05). There was no difference between the two groups as far as gender, tobacco, alcohol and dairy products intake, use of vitamin D and calcium supplements (vitamin D supplementation as calcidiol when used) and serum levels of Ca, P and Mg (Table 1).

Table1

Comparison baseline characteristics and phosphocalcic determinations between patients with Barthel Index ≤ 75 and > 75

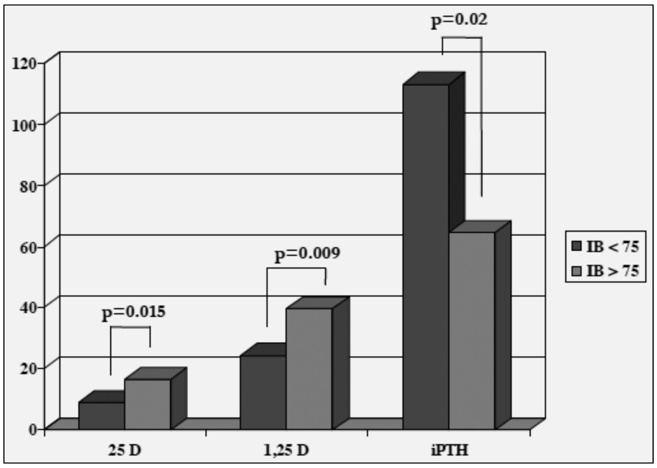
	BI ≤ 75	BI > 75
Age	81.29 (5.7)	76.00 (8.9)*
Sex	5V/9M	10V/35M
Tobacco	0	4.4%
Alcohol	14.3%	11.1%
Dairy products intake (mg/day)	929.55 (459.72)	877.93 (386.40)
Sun exposure	21.4%	51.1%**
Ca/vitD supplements	21.4%	33.3%
Calcium (mg/dl)	8.81 (1.1)	9.10 (0.6)
Phosphorus (mg/dl)	3.49 (1.0)	3.34 (0.9)
Magnesium (mg/dl)	1.88 (0.3)	1.49 (0.3)

Values expressed as a medium (DE) according to age and dairy products intake and in percentage for the rest of parameters (except for sex comparison); *p = 0.013; **p = 0.05

The mean of the total cohort was 14.48 (11.1) ng/ml, for 25 D, 35.78 (21.7) pg/ml for 1,25 D and 76.97 (52.6) pg/ml for iPTH. The patients with BI ≤ 75 had compared with the BI > 75 group lower levels of 25 D (8.93 (3.4) ng/ml vs 16.56 (12.5) ng/ml; p = 0.015) and of 1,25 D (24.39 (12.8) ng/ml vs 39.65 (21.1) pg/ml; p = 0.009), and higher levels of iPTH (113.29 (75.8) vs (64.59 (37.2) pg/ml; p = 0.020) (Figure 1). All patients with BI ≤ 75 had levels of 25 D below than 30 ng/ml compared with 84.4% of the patients with BI > 75. We found levels of 25D < 10 ng/ml (deficiency) in 71.4% of the patients with BI ≤ 75 and in 44.4% of the ones with de BI > 75 (Figure 2).

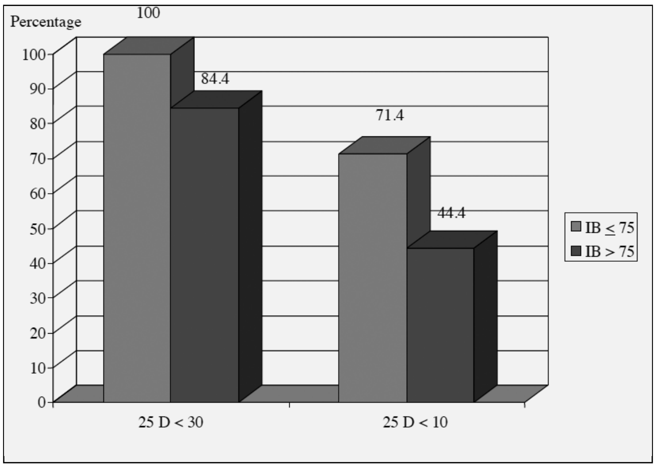
An inverse correlation between the levels of 25 hydroxyvitamin D and iPTH (r = 0.071) was seen. The logistical regression showed that the only factor that independently predicted values of 25 hydroxyvitamin D below 10 ng/ml was a BI ≤ 75 (OR: 4.58; IC 95%: 1.124-18.689; p = 0.034).

Figure 1
Plasmatic levels of 25 hydroxyvitamin D, 1,25 dhydroxyvitamin D and intact parathormone



25 D: 25 hydroxyvitamin D. 1,25 D: 1,25 dihydroxyvitamin D. iPTH: intact parathormone

Figure 2
Prevalence of leves of 25 D < 30 ng/ml and < 10 ng/ml (deficiency)



25 D: 25 hydroxyvitamin D.

Discussion

The results show a high prevalence of vitamin D deficiency in elderly patients. A relation between BI and 25 D levels was shown, and a BI below 75 is predictor of deficiency.

Vitamin D deficiency is an important problem worldwide. Is common in Southern Europe. Risk groups include elderly people, and supplements use is accepted as an important determinant for improving vitamin D status (6). Vitamin D deficiency varies from 2 to 30% in adults but increases up to 80% in institutionalized elderly (7). In Spain, the prevalence in postmenopausal women is up to 35.3% for values of vitamin D below to 10 ng/ml (8). Consistent with these findings, a recent demographic study shows that one-third of the Spanish population may be at risk for Vitamin D deficiency, and that vitamin D levels are related to age (9).

Although some studies show no benefit regarding secondary prevention of fractures, recent metaanalysis have demostrated that vitamin D supplementation is efficient in diminishing the risk of hip fractures as well as of any type of non-vertebral fracture (10, 11). Also it seems to decrease the risk of falls (12, 13) and, consequently, reducing the morbidity and mortality associated with femur fractures (14, 15). Therefore, has been suggested that vitamin D3 supplementation should be an integral part of effective osteoporosis management (13).

In agreement with our study, an elevated prevalence of vitamin D deficiency was described in patients admitted to the hospital (15), and a correlation with diminished mobility was seen (16). Two previous Spanish studies evaluated the association between functional capacity assessed by BI and vitamin D levels (17, 18). In one study, Vaqueiro et al. obtained a prevalence of 87.5% of vitamin D deficiency in a group of patients aged 65 years or more (16). In the second, Formiga et al. showed that more than half of the population aged 85 years had vitamin D insufficiency and 14.4% showed a deficiency. This percentage is lower than the one observed in the former study (17), probably because of the age difference between the groups analyzed in the two series. Formiga et al. showed that, although poor scores on the functional assessment together with other parameters are associated with vitamin D deficiency, after applying the regression model, only a lower score on the Mini Nutritional Assessment scale was significantly associated with low vitamin D serum values (18). They found no relationship between vitamin D deficiency and BI, nor were comorbidites and number of chronically prescribed drugs associated with any alteration in vitamin D levels. Furthermore they describe no association with cognitive status or the number of previous falls (18). In agreement with these results, our study found that the only independent predictive factor for vitamin D levels was the BI, although we haven´t analysed the same parameters used by Formiga et al. Therefore we found that a BI < 75 predicted levels of 25 hydroxyvitamin D compatible with deficiency.

It has been suggested that elderly patients, due to limited mobility and difficulty for walking, frequently require help in order to get out of the house. This leads to less sun exposure and, consequently, low vitamin D levels (19). In our study this aspect wasn´t completely confirmed as vitamin D levels weren´t associated with the degree of sun exposure.

Our study has a series of limitations. Firstly the fact that it had been conducted in only one center. Secondly the small number of the sample group analyzed could have led to a sampling bias although the results obtained in the logistical regression were sufficiently important as to validate. Finally having not performed other tests associated with vitamin D deficiency like the Mini Nutritional Assessment could represent a confusion factor in analyzing the results. Nevertheless we think that BI can be a useful tool in order to take decisions regarding the initiation of supplementation with vitamin D and calcium in elderly patients without need of measuring vitamin D plasma levels.

In brief, this study shows that a high prevalence of vitamin D deficiency exists in the patients aged 65 years or more that require assistance in the Emergency Department due to a nonsurgical cause, and that a BI below 75 predicts values of vitamin D less than 10ng/ml. Considering the results above mentioned we can deduce that all the patients aged 65 years or more that have a BI < 75 should be considered to receive calcium and vitamin D supplements.

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