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Inpatient Care Vitamin D Status in a Physical and Rehabilitation Medicine Department

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Abstract

Vitamin D is a prohormone whose two main inactive biological forms are cholecalciferol and ergocalciferol. Adequate levels of vitamin D are essential for innumerable organic functions, namely: muscle function, prevention of stress fractures, prevention of infectious diseases and may even contribute to the secretion of insulin in type 1 and 2 diabetics. In addition, low levels of vitamin D are associated with an increased risk of mortality.

In this study, we assessed the prevalence of vitamin D deficiency and inadequacy amongst the patients admitted to a Physical and Rehabilitation Medicine Department during the year of 2017 and determined the correlation of vitamin D serum levels and age. 27 patients were included in the study, 16 males (59.3%) and 11 females (40.7%). Ages were comprised between 38 and 84 years with a mean of 60.37 ± 13.85 years.

Serum vitamin D levels ranged from 4.4ng/mL to 24.6ng/mL, with a mean of 11.54 ± 5.87 ng/mL and no relevant differences were observed between genders (female group – 11.26 ± 6.97 ng/mL and male group – 11.73 ± 5.23 ng/mL). The overall correlation between age and vitamin D level was -0.482 ($p=0.01$), the female group -0.509 , $p=0.11$ and male group -0.506 , $p=0.04$.

Supplementation with cholecalciferol is safe and there are no reported cases of toxicity using the recommended doses. Given the effectiveness and safety of cholecalciferol in increasing serum 25(OH)D levels, supplementation of hospitalized patients may be considered.

Keywords: Vitamin D; 25(OH)D; Inpatient Rehabilitation; Spinal cord injury; Ischemic stroke; Intracerebral hemorrhage

Introduction

Vitamin D is a prohormone whose two main inactive biological forms are cholecalciferol and ergocalciferol. Cholecalciferol can be synthesized in human skin after exposure to ultraviolet-B light or can be obtained through food while ergocalciferol can only be obtained through food.

Serum 25(OH)D is a reliable biomarker considered the best determinant of vitamin D status [1]. Endocrinology Society defines vitamin D deficiency as 25(OH)D values below 20 ng/mL and insufficiency between 21 and 29 ng/mL. The sufficiency of vitamin D is defined as values between 30 and 100 ng/mL. Serum levels of 25(OH)D greater than 100ng/mL may be considered as toxicity [2].

Vitamin D deficiency has high prevalence rates and is being described as pandemic. In Europe, the prevalence was estimated in 13% in the general population [3]. A big variability exists worldwide regarding vitamin D status that can be explained through sun exposure and alimentation habits [4].

Some studies show the importance of adequate levels of vitamin D for skeletal health [5] and calcium homeostasis [6]. However, few is known about the full importance of vitamin D, which could be demonstrated by the presence of vitamin D receptors in nearly all nucleated human cells [7].

Adequate levels of vitamin D are essential for a variety of physiological functions such as muscle contraction, prevention of stress fractures, prevention of infectious diseases and may even contribute to the secretion of insulin in type 1 and 2 diabetics [8]. Recently, low levels of vitamin D were also associated with an increased risk of mortality [9].

Significant myopathy is a common feature in vitamin D deficient individuals and it seems that myopathy precedes bone disease, because the decrease of muscle power was present in vitamin D

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Table 1: Descriptive sample characterization.

Gender	Female	Male
number (%)	11 (40.7%)	16 (59.3%)
Age		
mean	66.36	56.25
minimum	42	38
maximum	84	78
standard deviation	13.06	13.20
Vitamin D		
mean	11.26	11.73
minimum	4.40	4.80
maximum	24.60	22.10
standard deviation	6.97	5.23
Etiology		
Traumatic brain injury	0	1
Spinal cord injury	7	5
Immobilization syndrome	0	1
Hemorrhagic stroke	0	4
Ischemic stroke	3	3
Guillan Barré syndrome	0	1
Polyneuropathy	0	1
Polytrauma	1	0

deficient individuals with or without bone changes [10].

Furthermore, in a Tunisian study realized with young athletes, Bezrati I et al. reported a positive correlation between vitamin D and physical performance [11].

Supplementation with cholecalciferol is safe and there are no reported cases of toxicity using the recommended doses [12]. A reason for the absence of vitamin D toxicity is the fact that both (the active and inactive) forms of vitamin D stimulate their own destruction. This occurs through metabolization of 25(OH)D and 1,25(OH)₂D into water-soluble inactive forms by 25-hydroxyvitamin D-24-OHase (CYP24R) [2].

In this study, we assessed the prevalence of vitamin D deficiency and inadequacy amongst patients admitted to a Physical and Rehabilitation Medicine Department. In addition, the relationship between vitamin D levels, gender and age was assessed.

Materials and Methods

The inclusion criterion of the present study was being a patient admitted to the Physical and Rehabilitation Medicine Department during 2017.

Patients were classified into two groups according to gender. Age, vitamin D level and the admission reason were also registered.

All patients were evaluated and blood samples were collected at admission including serum 25(OH)D. The skin type was also evaluated according to the Fitzpatrick scale.

Vitamin D assay was performed using the ADVIA Centaur XP Immunoassay System® (SIEMENS®) and is intended for in vitro diagnostic use for the quantitative determination of total 25(OH)D in human serum.

The ADVIA Centaur Vitamin D assay® is an 18-minute competitive immunoassay with antibodies. It uses a mouse monoclonal antibody anti-fluorescein covalently associated with paramagnetic particles; an acridine ester-labeled mouse monoclonal antibody anti-vitamin 25(OH)D and a fluorescein-labeled vitamin D analog. There is an inverse relationship between the amount of vitamin D present in the patient sample and the amount of relative light units detected by the system.

Samples were collected in a dry tube with coagulation activator – glass beads, and the tube was immediately wrapped in tin foil that prevents the passage of light and consequent degradation of the vitamin D sample. Samples were taken to the laboratory within one hour. There, they were received, identified and centrifuged for 10 minutes at 1000G in a refrigerated centrifuge. The serum obtained from the samples, when not analyzed in a period of 24 hours, was stored at 2 - 8 °C and then analyzed in a period not exceeding 7 days. During all these procedures, the samples were always sheltered from light. The results obtained from the analysis of the samples were presented in ng/mL.

After establishing serum vitamin D inadequacy or insufficiency, the patients were treated with 2000 IU/day of cholecalciferol.

Statistical analysis was performed using the IBM SPSS Statistics software, version 21. Sample normal distribution was analyzed by visual inspection and Kolmogorov-Smirnov and Shapiro-Wilk tests.

The correlation between age and vitamin D level were determined using Pearson correlation analyses. A p-value < 0.05 was considered statistically significant.

Results

27 patients were included in the study, 16 males (59.3%) and 11 females (40.7%). Ages were comprised between 38 and 84 years of age with a mean age of 60.37 ± 13.85 years.

All patients had a score of 3 on the Fitzpatrick scale.

Patients main diagnoses were spinal cord injury, ischemic stroke and intracerebral hemorrhage as described in Table 1.

Serum vitamin D levels ranged from 4.4ng/mL to 24.6ng/mL, with a mean of 11.54 ± 5.87 ng/mL and no relevant differences were observed between groups (female group – 11.26 ± 6.97 ng/mL and male group – 11.73 ± 5.23 ng/mL).

The overall correlation between age and vitamin D level was -0.482 (p-value 0.01) meaning a statistically significant negative correlation between the two variables.

Thus, none of the patients had adequate levels of vitamin D and only 4 had inadequate levels. The remaining 23 patients had vitamin D insufficiency.

Due to the diversity of the pathologies, it was not possible to establish a relationship between etiology and serum levels of vitamin D.

Discussion

Vitamin D deficiency and inadequacy reaches concerning levels amongst general population worldwide and may reach even more worrying levels in risk populations. Inpatients comprising intensive rehabilitation programs will share many risk factors such as low sun exposure and higher physical activity. In this study, we showed that

the prevalence amongst inpatient population is much higher than the prevalence estimated for general population, with none of the patients having adequate serum 25(OH)D levels.

We also reported a negative correlation between age and vitamin D level, which can be related to poor sun exposure, lower nutritional intake or the higher prevalence of chronic diseases in older individuals.

Specifically, in these patients admitted for an intensive rehabilitation program, vitamin D deficiency may contribute to the appearance of complications such as fractures, pulmonary or urinary tract infections and even risk of mortality. Vitamin D deficiency may contribute to a further delay in the functional recovery of patients and prevent them from achieving full recovery potential.

Given the effectiveness and safety of cholecalciferol in increasing serum 25(OH)D levels, we may consider supplementation or even fortification of all hospitalized patients in order to prevent complications and enhance their functionality.

Conclusions

None of the patients admitted to the Physical Medicine and Rehabilitation Department to undergo an intensive rehabilitation program had adequate levels of vitamin D. Furthermore, there was a moderate but statistically significant negative linear correlation between age and serum vitamin D levels.

Thus, the prevalence of vitamin D deficiency and inadequacy in hospitalized patients reached alarming levels, that can foreclose the completion of an intensive and successful rehabilitation program, particularly in older patients.

More studies are needed for a better understanding of the prevalence of vitamin D amongst patients in intensive rehabilitation programs, if all patients should be supplemented and what doses should be considered.

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