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Impact of Vitamin D deficiency on Rehabilitation Outcome

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Abstract

Vitamin D deficiency, which can result from inadequate sun exposure, dietary intake, or problems with absorption, is rarely documented in the rehabilitation literature. Most likely, it is rarely thought of by the rehabilitation profession. This is problematic because vitamin D deficiency can present as musculoskeletal pain, which is commonly seen in both outpatient clinics and inpatient rehabilitation units. The populations with the greatest risk include the homebound elderly, people with pigmented skin, people with cultural and social avoidance of the sun, people who live in wintertime in climates above and below latitudes of 35 degrees, and people with gastrointestinal absorption.

Vitamin D deficiency should be included in the differential diagnosis in the evaluation of musculoskeletal pain complaints in the rehabilitation setting, and treatment of any identified deficiency should be considered a potentially important component of the treatment regimen.

Introduction

25-hydroxyitamin D deficiency is common amongst various populations worldwide. As per previous studies the prevalence of vitamin D deficiency varies greatly due to differences in definitions used and it ranged from 57% to 74% in in-patient medical population [1,2]. 70.3% and 67% of an acute inpatient rehabilitation population and outpatient rehabilitation population respectively were found to have a serum 25-hydroxyvitamin D of less than 30 ng/ml [3,4]. Vitamin D deficiency has been classically recognized for its role in bone health, however there is increasing evidence of its role in extra-skeletal health. Investigators of most prospective studies reported moderate to strong inverse associations between 25(OH) D concentrations and cardiovascular diseases, serum lipid concentrations, inflammation, glucose metabolism disorders, weight gain, infectious diseases, multiple sclerosis, mood disorders, declining cognitive function, impaired physical functioning, and all-cause mortality [5].

There have been several studies published on the vitamin D status of rehabilitation patients except one study none of them included significant number of patients from Asia [6].

We therefore, performed this pilot study with the primary objective of determining the prevalence of vitamin D screening and association of vitamin D status with functional outcome in a sampling of patients in an in-patient rehabilitation unit tertiary care hospital in Singapore. A secondary objective was to evaluate variables that may influence vitamin D status.

Methods

The rehabilitation unit is located within the campus of a regional hospital and is well equipped with all the modern facilities for both in and out patient referrals. The majority of patients referred are stroke, acquired brain injury, spinal cord injury and complex medical and post-surgical deconditioning.

This is a retrospective cohort study involving the review of electronic medical records of all patients discharged from a general rehabilitation inpatient unit located within a general hospital in Asia. The review period was from 1st July 2014 to 30th June 2015. Medical records of patients discharged within the review period were screened for serums 25-hydroxyvitamin D results which were obtained during the same admission. Patients with end stage renal failure on dialysis or stage V chronic kidney disease were then excluded.

Demographic data (age, gender, race), primary rehabilitation diagnosis, length of stay, discharge destination, medical comorbidities, body mass index, bone mineral densitometry, Functional Independence Measure (FIM) on admission and discharge and serum 25-hydroxyvitamin D level for each patient were collected.

In this study, we have defined vitamin D deficiency based on the Endocrine Society Clinical Practice Guideline, which is that of a serum 25-hydroxyvitamin D level less than 20 ng/ml.

The FIM is a functional assessment tool commonly used in the inpatient rehabilitation setting. Eighteen different activities (13 motor, 5 cognitive) are scored on a scale of 1 to 7, with a score of 1 indicating complete dependence and 7 indicating complete independence. By adding the scores for each subscale, a total score can range from 18 points (lowest possible level of functional independence) to 126 points (highest possible level of functional independence). FIM efficiency is calculated by dividing the difference in discharge and admission FIM scores by inpatient rehabilitation length of stay [6].

Statistical analysis was performed using SPSS 19 statistical software, version 19.0 (IBM Corp. Armonk, NY) and statistical significance is set at $p<0.05$. Categorical data is presented as frequency (percentage). Numeric data is presented as mean (standard deviation) for parametric distribution and median (interquartile range) for non-parametric distribution. The differences in characteristics were examined using Chi-Square test for categorical variables and 2-sample t-test for continuous variables.

This study is approved by the Singhealth Centralised Institutional Review Board.

Results

There were a total of 746 patients discharged from the inpatient rehabilitation unit from 1st July 2014 to 30th June 2015. Out of these, 52 patients had serum vitamin D levels checked during their admission of the 52 patients with vitamin D levels available, 29 (55.8%) patients were found to be vitamin D deficient (less than 20 ng/ml). Within these 29 vitamin D deficient patients: 38.5% were post stroke, 32.7% were admitted for medical or surgical deconditioning (Table 1).

Characteristics	N = 52 (%)
Gender	
Male	23 (44.2)
Female	29 (55.8)
Race	
Chinese	43 (82.7)
Malay	7 (13.5)
Indian	2 (3.8)
Mean Age [range]	70.4 [15 to 89]
Rehabilitation diagnosis	
Stroke	20 (38.5)
Trauma	5 (9.6)
Deconditioning	17 (32.7)
TBI	1 (1.9)
Amputee	1 (1.9)
Others	8 (15.4)
Nursing home patient	
Yes	3 (5.8)
No	49 (94.2)
Ambulatory status	
Community ambulant	30 (57.7)
Home bound	22 (42.3)
Working	
Yes	7 (13.5)
No	45 (86.5)
Admitted to ICU	
Yes	7 (13.5)
No	45 (86.5)
Discharge destination	
Home	29 (55.8)
Community hospital	17 (32.7)
Nursing home	4 (7.7)
Others	2 (3.8)
Vitamin D<20 ng/ml	
Yes	29 (55.8)
No	23 (44.2)

Table 1: Clinical characteristics of patients.

A number of patients' characteristics including rehabilitation outcome were analysed. Patients with Vitamin D deficiency achieved lower total FIM gain during inpatient rehabilitation. A greater proportion of darker skin patients (Malay and Indians) were found to be Vitamin D deficient. However, none of them reached statistical significance (Table 2).

Characteristics	Vitamin D>=20	Vitamin D<20	P value
Age	71.0	69.9	NS
Albumin	31.6	31.6	NS
Haemoglobin	12.6	12.7	NS
Total FIM gain	11.0	8.1	NS
Motor FIM gain	8.0	6.2	NS
Cognitive FIM gain	1.8	1.2	NS
BMI at admission	23.6	21.1	NS
LOS			
Total	34	32	NS
Rehabilitation	26	23	NS
Gender			
Male	7	16	
Female	16	13	NS
Race			
Chinese	22	21	
Malay	1	6	
Indian	0	2	NS
Ambulatory Status			
Homebound	10	12	
Community ambulant	13	17	NS
Working			
Yes	4	3	
No	19	26	NS
ICU admission			
Yes	4	3	
No	19	26	NS
Presence of 3 cardiovascular risk factors*	4	7	
Yes	19	22	NS
No			
Diagnosed osteoporosis			
Yes	4	6	
No	19	23	NS
Osteoporotic fracture			
Yes	5	7	
No	18	22	NS

Table 2: Comparison of parameters between vitamin D deficient and non-deficient groups; NS: Not Significant.

Discussion

In our pilot study 55.8% patients were found to have vitamin D deficiency. Vitamin D deficiency is a significant problem in the in-patient rehabilitation patients even in tropical Singapore where there is abundant sunshine year round.

Previous studies examining the association between vitamin D deficiency and rehabilitation outcomes had been published. A prospective study by Klebzak et al. [7,8] done in a general rehabilitation unit of a hospital located in the United States, that length of stay and FIM efficiency were favorably affected by higher vitamin D level.

However, in another study from the United States, unadjusted total FIM efficiency scores were statistically significant in association with vitamin D status.

Vitamin D status was not significant factor in relation to the total FIM efficiency score after controlling for demographic and clinical factors. In our pilot study, there was a trend towards a larger total FIM gain in patients with normal vitamin D level group as compared to the vitamin D deficient group, although this difference was statistically insignificant.

It was found in a prospective cohort study from Singapore that age, gender, vitamin D supplementation, premorbid ambulatory status, and admission/discharge FIM scores were not significantly associated with vitamin D deficiency. Malays, Indians and patients with recurrent falls were at higher risks for vitamin D deficiency [9]. The findings were largely in congruent with the our pilot study, apart from the racial difference.

In another prospective study, Gradel demonstrated an association between vitamin D insufficiency and deficiency with adverse clinical and functional outcomes. 68% of patients attending rehabilitation outpatient clinics who were not on vitamin D supplementation were either vitamin D insufficient or deficient. This suggests that vitamin D deficiency is not just confined to the rehabilitation in-patients.

The question remains whether vitamin D supplementation translates to clinical benefits. Results from a recent review by Grädel et al. [10] showed that high-quality evidence from interventional trials on the benefits of vitamin D supplementation in inpatients is currently lacking. The authors concluded that vitamin D screening and supplementation for the medical inpatient population in an acute care setting cannot be recommended based on current available evidence.

There is evidence to support an association between high body mass index and vitamin D deficiency. A study consisting of well community dwelling adults in Asia showed that higher BMI and larger waist circumference were significantly associated with lower vitamin D levels. There was a trend towards a higher BMI for patients who were vitamin D deficient however these results were not statistically significant.

Limitations of our study

It is a retrospective pilot study and some of the data was incomplete. The sample size is small and hence it may not represent all rehabilitation inpatients. The patients who had serum 25-hydroxyvitamin D levels obtained during their inpatient stay were more likely to be identified as having high risk for deficiency [11]. As the majority of the patients did not have vitamin D levels done, the comparison of these two groups was not possible.

Conclusion

A systematic prospective study may be helpful on Asian population, in both inpatient and outpatient rehabilitation setting to determine the prevalence of vitamin D deficiency. This can also then determine the cost effectiveness of screening the inpatient rehabilitation population.

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