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Association between Vitamin D Deficiency and High or Low Energy Fractures among Patients above 45 Years Old in Riyadh

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ABSTRACT

Background: *An essential element in the equilibrium of calcium in the body is Vitamin D. It prompts adding calcium into the circulation. As a result, it could have a significant role in preventing the occurrence of high and low energy fractures. The point of this study was to find an association of Vitamin D deficiency with low or high energy fractures among patients older than 45 years old in King Abdulaziz Medical City in Riyadh.* ***Method:*** *This was a retrospective cross-sectional study that was conducted from January 2015 to December 2017 at the Orthopedic department in KAMC-Riyadh. A total of 230 Saudi fracture patients older than 45 years old with measured Vitamin D levels were reviewed. The variables included age, gender, 25-hydroxyvitamin D level, and type of fracture; high vs. low-energy fracture. The deficiency was considered as serum concentrations of 25(OH)D<50 nmol/L.* ***Results:*** *There was a high prevalence of 25-hydroxyvitamin D deficiency 25(OH)D<50 nmol/L in (62%) among the study sample. This study found no association between 25-hydroxyvitamin D deficiency with fracture type (p=0.75) with high energy fractures (63%, 66/105) vs. low energy fractures (61%, 76/125), respectively.* ***Conclusion:*** *In spite of the high prevalence of deficiency within all fracture patients, these results are comparable to previous studies on the normal non-fracture population. More studies are required to look into more factors that might increase the probability of fractures..*

Keywords: 25-hydroxyvitamin D, Vitamin D deficiency, Prevalence, Saudi Arabia, Humans

INTRODUCTION

Vitamin D, which is also called calciferol, refers to a group of fat-soluble seco-sterols [1]. Vitamin D has two forms that have the same effects and metabolism but differ in their side chain [2]. Vitamin D3 is naturally made by the skin after sun exposure [1]. The other form is Vitamin D2 (ergocalciferol) which is a commercially synthesized form from obtaining ergosterol from yeasts [2]. The liver then metabolizes Vitamin D into 25(OH)D which is used as a measurement of vitamin D status [2]. Vitamin D plays a major role in calcium homeostasis in the bone. It induces enterocytes to get calcium into the circulation [3]. As a result, it could have a significant part in preventing the occurrence of both high and low energy fractures. Low energy fractures are any fracture that results from a falling from a standing height or less. While high energy fractures are defined as any fracture that results from a fall higher than the standing height or from a motor vehicle accident [4].

People who are considered Vitamin D deficient have lower levels of 25(OH)D than 30 nmol/L [1,5]. As vitamin D deficiency becomes a worldwide problem, a lot of researchers have directed their efforts and have done a lot of investigations behind this common phenomenon. Vitamin D deficient people may experience fatigue, muscle pain, and depression [6-8]. Studies found that deficiency is more common in the elderly, non-white race, postmenopausal women [9,10], intestinal malabsorption syndrome such as celiac disease and Crohn's disease [11], as well as asthmatic patients [12]. Although Saudi Arabia is one of the sunniest countries worldwide, epidemiological studies have shown that a high prevalence of the Saudi population is deficient in Vitamin D [13,14]. One study was conducted in

KAMC-Riyadh, which involved 3475 participants, showed that 49% of females and 36% of the male had 25(OH) D<25 nmol/L [13].

With the major effects of Vitamin D on bone density [15] and calcium homeostasis [2], its effects on patients who undergo either low or high-energy fractures might be remarkable. This study aimed to investigate an association between Vitamin D deficiency and both high or low-energy fractures among patients older than 45 years old in KAMC-Riyadh. Investigating this association will help physicians to promote a protocol to prevent bone fractures by Vitamin D supplements among high-risk patients and to raise awareness of Vitamin D importance among the Saudi population.

METHODS

This was a retrospective cross-sectional study that was conducted in 2017. The study was approved by the Institutional Review Board, at King Abdullah Medical International Research Center, Riyadh, Saudi Arabia. This study was conducted at the Orthopedic Department in King Abdulaziz Medical City at the National Guard in Riyadh, which is a tertiary referral hospital with accommodation 1500 beds. It serves mainly the National Guard employees and their families. Besides, it has its own university; hence, it is a university-based center.

The study was performed to identify an association between Vitamin D level status in both high and low energy fractured patients older than 45 years old between 2015 to 2017. High energy fractures are defined as any fracture that results from falling higher than the standing height or from a motor vehicle accident. While low energy fractures are any fracture that results from a falling from a standing height or less [4] All Saudi males and females older than 45 years old with low or high energy fracture who had a 25-hydroxyvitamin D blood level test available on medical records were included. On the other hand, any contributing risk factors for Vitamin D deficiency, such as renal insufficiency, gastric surgery, intestinal mal-absorption, active liver disease, or steroid-dependent patients were excluded.

A consecutive sample was used since all patients who met the inclusion criteria were included. We identified (n=125) with low energy fracture and (n=105) with high energy fracture whose data were reviewed from charts from BEST-Care, a computerized data system. Data were collected from medical records including sociodemographic characteristics like age, gender, body mass index and nationality.

At KAMC, serum level of 25(OH)D is done by Chemiluminescence microparticle immunoassay (CMIA). Vitamin D deficiency was defined as serum concentrations of 25(OH)D<50 nmol/L. A study reported that serum concentration of 25(OH)D ≥ 50 nmol/L is regarded as an adequate level of Vitamin D [16]. Fracture type was documented and collected from the charts based on the patient's history.

Data was entered and analyzed by using SPSS v20. Descriptive statistics were presented as frequency and percentage for categorical variables such as gender and fracture type. For numerical variables such as age, were presented by the mean and standard deviation. The level of Vitamin D was classified into deficient and non-deficient in all low and high energy fracture patients and was compared by using Chi-square at a level of significance of 0.05.

RESULTS

A total of 230 fractured patients were included in the study. There were 112 males (49%). One hundred twenty-five of which were low energy fractures (54%). Remarkably, most of the population in this study had a single bone fracture (97%). Furthermore, spine fractures accounted for (21%), femur (17%), radius (12%) and ankle (9%) (Table 1). The mean age of patients was 64.9 ± 12.8 years. The mean BMI of the population was 29.4 ± 7.3 kg/m^2. The mean calcium level in this study was 2.2 ± 0.2 nmol/L (Table 2).

This study showed a high prevalence of 25-hydroxyvitamin D deficiency 25(OH)D<50 ng/ml in 61.7% among the study sample. The mean of 25(OH)D was 50.1 ± 30.3 nmol/L while the median was 44.5 nmol/L. There was no significant association between 25-hydroxyvitamin D deficiency with fracture type (p=0.75) with high energy fractures (63%, 66/105) *vs.* low energy fractures (61%, 76/125), respectively (Table 3).

In comparison among genders, we found that men were more likely to be Vitamin deficient than women (p=0.003). This was more prevalent in men (52.5%) than women. Particularly, this was noted among high energy fracture populations where remarkably more men (73%, 45/61) than women (47%, 21/44) were Vitamin D deficient (p=0.006). In contrast, this significance was not observed in the low energy fracture group (p=0.14).

Table 1 Descriptive statistics for categorical data (original)

Variables	N*	(%)
Gender		
Male	112	48.7%
Female	118	51.3%
Fracture Type		
Low Energy Fracture	125	54.3%
High Energy Fracture	105	45.7%
Fracture Site		
Spine Fracture	49	21.3%
Femur Fracture	41	16.8%
Radius Fracture	27	11.7%
Ankle Fracture	20	8.6%
Weight		
Underweight	15	6.6%
Normal	50	22%
Overweight	66	29.1%
Obese	96	42.3%
*Frequency		

Table 2 Descriptive statistics for the numerical data (original)

Variables	Mean	Standard Deviation	Median	Percentile 25	Percentile 75
Vitamin D	50.1	30.3	44.5	32.1	59.1
Age	65	13	62	55	75
Height	161	11	160	154	168
Weight	76	18	76	63	88
BMI	29	7	29	25	34
Calcium	2.2	0.2	2.2	2.1	2.3

Table 3 Vitamin D status vs. fracture type and gender (original)

Variables		Vitamin D Status				p-value
		25(OH)D<50 nmol/L		25(OH)>50 nmol/L		
		N*	%	N*	%	
Fracture type	Low energy fracture	76	60.8	49	39.2	0.75
	High energy fracture	66	62.9	39	37.1	
Gender	Male	80	71.4	32	28.6	0.003
	Female	62	52.5	56	47.5	
* Frequency						

DISCUSSION

This study results revealed that among fracture patients, men were significantly more likely to be Vitamin D deficient. Overall there was a high prevalence of Vitamin D deficiency among men in both low and high energy fracture groups (67%, 73%, respectively). In contrast, Steele, et al. [17], has found that women were significantly more likely to be Vitamin D deficient especially in low energy fracture group. There is generally an argument regarding gender effect on Vitamin D level. Most studies have shown women are more common to have 25-hydroxyvitamin D deficiency among all populations [18]. Furthermore, in a study that included 3475 patients which were conducted in Saudi Arabia, they found females had a significantly higher prevalence of vitamin D <50 nmol/L than males [13]. In contrast, other studies revealed that men are more probable to have 25-hydroxyvitamin D deficiency. Lee, et al. [19] found a

high prevalence of vitamin D deficiency in both types of fractures, especially in postmenopausal women. Nevertheless, Lee, et al. identified multiple bones fractures as the most common. In contrast, our study showed that the single bone fractures are the most common.

Johnson, et al. [20] have found an association between morbidly obese women and men and vitamin D deficiency. Some evidence suggested that obesity playing a role in decreasing vitamin D levels by 4% for each 10% increase in BMI [21]. This can explain our study result since we have a high percentage of 42% of obesity in our study.

Differences in this study results in comparison to literature arise from several sources. For example, Steele, et al. study included only 44 fractured patients. In addition, the study only included fractured patients who have had a Vitamin D test immediately after orthopedic surgery [17]. In comparison to this study, the sample size was 230 fractured patients. Moreover, the dates of the Vitamin D level test were taken regardless of the time of fracture. As well, the age of patients in this study was 45 years and above while steel, et al. included 18 years and above.

Multiple studies have demonstrated that Vitamin D supplements decrease bone fractures incidence. A meta-analysis of twelve double-blind RCTs (n=42,279) that were incorporated for analysis with at least one-year follow-up that compared oral Vitamin D supplementation (with or without calcium) with placebo or calcium alone. In these trials, Vitamin D supplementation (482-770 IU/day) remarkably reduced both Nonvertebral and hip fractures by at least 20% [22].

A guideline for Vitamin D treatment is applied for patients with deficiency. Moreover, Patients with 25-hydroxyvitamin D (25[OH]D) less than 25 nmol/L, the dose of Vitamin D usually is 50,000 international units orally once weekly for six to eight weeks, and then a maintenance dose of 800 to 1000 international units afterward. In patients whose 25-hydroxyvitamin D (25[OH]D) level between 25 to 50 nmol/L, the dose usually includes 800 to 1000 international units daily, typically for a three-month period, then a dose of 800 international units daily is recommended [23]. Since there was a high prevalence of 25-hydroxyvitamin D deficiency within the fracture population especially men, patients who are at risk should be tested for deficiency and treated according.

This study had some limitations. It included patients regardless of prior Vitamin D supplementation. In addition, the dates of the Vitamin D level test were taken irrespective of the time of fracture. Moreover, this may be the result of not having a protocol of doing a Vitamin D blood test for high-risk patients after being admitted to a fracture in the hospital. Another limitation is that it was based in a single center.

CONCLUSION

We conclude that a high prevalence of deficiency is commonly seen in patients with fractures. The prevalence was comparable to previous studies on the normal non-fracture population. Moreover, no association of deficiency of Vitamin D with the type of fracture was found. We recommend doing more studies to investigate gender and its association with different types of fractures in the Arab region.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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