Original Research Article

Association of calcium and Vitamin D levels in fragility fractures in the elderly: A study in a tertiary care centre

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ABSTRACT

Introduction: One of the most common morbidities that is associated with the elderly is the fragility fractures. The common areas where the fragility fractures occur are pelvis, forearm and ribs in the elderly especially the persons aged more than 65 years. Of the various lines of treatments available for osteoporosis, one of the primary managements are Calcium and Vitamin D. This study was done therefore to assess the levels of vitamin D among the elderly with fragility fractures.

Materials and Methods: 76 patients over the age of 60 years, who had been admitted in our hospital due to fragility fractures, who were mobile, either independently or with help such as stick, walking frame or wheel chair were included into the study. The Vitamin D₃ levels were classified as sufficient, insufficient and deficient based on Pearce et al classification. Statistical analysis using graphs and tables and fisher's test was done.

Results: Out of 76 patients, 27.6% were males and 72.4% were females and the mean age was 75.9 ± 4.6 . Majority of the patients with fractures (47.4%) were either walking with 2 sticks or with a walking frame at the time of their fall. 56.6% of the patients had insufficient Vitamin D levels in their blood stream, 23.7% had deficient levels (<25 nmol/lit), 14.5% had sufficient levels and 5.3% were in the optimal range (>75 nmol/lit).

Conclusion: Most of the patients were either had insufficient or deficient Vitamin D level at the time of their fall. Therefore, it is imperative to keep a watch on the vitamin D levels and supplement calcium and vitamin D in medications so that the risk of fall is reduced.

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1. Introduction

One of the most common morbidities that is associated with the elderly is the fragility fractures. The main cause of fragility fractures is due to osteoporosis.¹ Osteoporosis is a very common skeletal disease the results in progressive destruction of the skeletal mass and the microarchitecture of the bone.¹ Osteoporosis is estimated to occur in 50% of the females and in 20% of the males worldwide. It is thus, one of the most commonly encountered conditions.² The most common complication due to the fragility fractures is death. There has been a marked increase of 3.17 times risk of death in the first year after a fragility hip fracture. In case

of vertebral fracture, the risk of death is 2.71 times in the second year.³

Osteoporosis is of two types- primary osteoporosis, which is due to the normal ageing of the individual, which usually results in the lowered levels of estrogen, and secondary osteoporosis which is due to other diseases such as low Vit D levels, diabetes type 2, cardiovascular disease and others.⁴⁻⁶ The causes of osteoporosis can be a mix of genetic, metabolic and environmental factors such as alcohol consumption, smoking, low physical activity, low sun exposure. Medications such as anticonvulsants and glucocorticoids also have a great affect on osteoporosis.⁷ The common areas where the fragility fractures occur are pelvis, forearm and ribs in the elderly especially the persons aged more than 65 years. In such patients, the morbidity is

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high, with severe health and social problems not to mention the increase in expenditure.⁸ Hip fractures are usually associated with chronic pain, disability, reduced mobility of the person and therefore a longtime nursing care, with increased mortality rate. The mortality rate is more common in men than women.^{9–14}

Therefore, the prevention and the treatment of these fragility fractures is very important to reduce the morbidity and mortality of the patients. Of the various lines of treatments available for osteoporosis, one of the primary managements are Calcium and Vitamin D.¹⁵ Bone consists of a very high density of calcium and this is dependant on the intake of calcium during adolescence. As the age progresses, the density begin to slowly reduce. A high intake in the younger years will help in the slow age related loss of calcium in the body.^{16–19} Inadequate intake of calcium will increase the prevalence of osteoporosis as the age advances.²⁰ Vitamin D is one of the important agents which helps in the absorption of calcium in the body, and also reduces with age.²¹ Apart from calcium homeostasis, Vitamin D also is reported to have an effect on the muscular strength, receptors of which are expressed in the skeletal muscle tissue. Studies have shown that lower levels of Vit D are associated with a higher risk of falls and fractures.^{22,23}

The normal dosage of the supplementation in elderly is 1200 IU of calcium and 800IU of Vit D per day.^{24–26} Vit D insufficiency is classified into mild, moderate and severe. Mild insufficiency ranges from 25–50 nmol/l of serum 25OHD, moderate is 12.5–25 nmol/l and severe is <12.5nmol/l.

This study was done therefore to assess the levels of vitamin D among the elderly with fragility fractures.

2. Materials and Methods

This prospective hospital based study was done by the Department of Orthopedics at RVM institute of medical sciences and research center from November 2019 to April 2020. 76 patients over the age of 60 years, who had been admitted in our hospital due to fragility fractures were included into the study. All the persons who were included were mobile, either independently or with help such as stick, walking frame or wheel chair. Those bedridden persons who sustained fractures due to falling off were excluded from the study. All the subjects had no serious medical ailments and had a life expectance of another 10 years. Persons who received drugs which can alter the bone metabolism were excluded, such as corticosteroids, anticonvulsants, thyroxine or fluoride salts.

This study was done after the approval of the institutional ethical committee clearance and after attaining the informed consent from all the subjects. The demographic details such as age, height, weight, Body Mass Index was collected from all the patients. They were subjected to medical and clinical analysis. The nature and the extent of the fracture

was confirmed by X-Ray of the concerned area. Blood was collected and regular investigations such as hemoglobin, complete blood picture, random blood sugar, cholesterol alkaline phosphatase, creatinine were done using standard methods.

The Vitamin D₃ levels were classified as sufficient, insufficient and deficient based on Pearce et al classification¹. Statistical analysis using graphs and tables and fisher's test was done.

3. Results

76 patients with fragility fractures in different parts of the body were included into the study. Out of them, 21 (27.6%) were males and 55 (72.4%) were females (Figure 1).

Fig. 1: Gender categorization of the patients

All the patients included in the study were above 60 years of age, the mean was 75.9 ± 4.6 , with the range being 60 – 92 years, the oldest being 92 years old. The BMI was measured for all the patients based on the height and weight. Out of the 21 males, 1 (4.8%) was underweight, with a BMI of <18.5, 5 (23.8%) had a normal BMI, 14 (66.7%) were overweight while 1 (4.8%) was obese. Among the women, 5 (9.1%) was underweight, 11 (20%) had normal BMI, 26 (47.3%) were overweight, 13 (23.7%) were obese. This data showed that there was a significant relation to a higher BMI and fragility fractures (Table 1).

Majority of the patients with fractures (47.4%) were either walking with 2 sticks or with a walking frame at the time of their fall. 11 (14.5%) of the patients were independently walking, without any support, while 25 (32.9%) of them were walking with slight support, mostly with the help of a stick. In some cases, an attender or a family member aided the patient to walk. 4 (5.3%) of them

Table 1: General details of the patients

Variables	Males n=21	Females n=55
Mean Age	75.9 ± 4.6	72.4 ± 7.1
Mean weight (kgs)	82.67 ± 9.1	74.66 ± 4.6
BMI		
Underweight (<18.5)	1 (4.8%)	5 (9.1%)
Normal (18.5 – 24.9)	5 (23.8%)	11 (20%)
Overweight (25.0 – 29.9)	14 (66.7%)	26 (47.3%)
Obese (>30)	1(4.8%)	13 (23.7%)

were on a wheelchair (Table 2).

Table 2: Mobility of the patients

Mobility	Number	Percentage
Unaided walk	11	14.5%
Walk with help / 1 stick	25	32.9%
Walk with 2 sticks/ frame	36	47.4%
Wheelchair	4	5.3%

At the time of admission, 43 (56.6%) of the patients had insufficient Vitamin D levels in their blood stream, 18 (23.7%) had deficient levels (<25 nmol/lit). 11 (14.5%) had sufficient levels and 4 (5.3%) were in the optimal range (>75 nmol/lit) (Table 3)

Table 3: Classification of Vit D levels in patients

Vit D Levels	Number	Percentage
Optimal (>75 nmol/lit)	4	5.3%
Sufficient (50-75 nmol/lit)	11	14.5%
Insufficient (25-50 nmol/lit)	43	56.6%
Deficient (<25 nmol/lit)	18	23.7%

Most of the patients were admitted due to fracture of the hip during the fall, which was seen in 33 (43.4%). 9 (11.8%) each had fracture of the wrist or hip and wrist, followed by 7 (9.2%) with vertebral fractures (Figure 2).

Fig. 2: Location of fracture

At the time of admission, majority of the patients 57 (75%), were not on any supplements, neither calcium of calcium with Vit D. 13 (17.1%) however were taking Calcium as well as Vit D₃ supplements and 6 (7.9%) were taking only Calcium supplements (Figure 3).

Fig. 3: Supplements taken by the patients

4. Discussion

Low vitamin D levels are very often seen in elderly patients along with low calcium levels. This results in fragility fractures in these patients, with severe morbidity and mortality.²⁷

In the present study, the number of females were 2 to 3 times more than the males. A study by Saini et al reported the male to female ration to be 1:3.5,²⁸ however in other studies such as that by Gallacher et al found no significant difference with sex of the patient to be associated with lower vitamin D levels.²⁹ The mean age in our study was 75.9 years in males and 72.4 years in females. A study by Gallacher et al reported 80.5 years to be the mean age among the patients with osteoporosis.³⁰

In our study, 47.4% of the patients were walking with 2 sticks or a frame prior to the fall and subsequent fracture and 32.9% were walking with help or a stick. In a similar study by Saini et al, 52% of the patients walked with the help of a stick and 11.8% of them walked with the help of 2 sticks or a frame.²⁸

BMI seems to play an important role in the Vit D levels. Around 70% of the patients were either overweight or obese.

It has been reported that BMI is significantly associated with the Vitamin D deficiency and could be due to sequestration of Vit D in the compartments of the body fat, thereby reducing the bioavailable Vit D.³⁰

The daily necessary levels of Vitamin D is 400-800IU. Most of it is attained from sunlight. As the age increases, the outdoor activities of the persons reduces. As the person spends more and more time indoors, the level of Vit D also reduces.

In our study, 56.6% of the patients had Vit D insufficiency and 23.7% were deficient in Vit D. In a study by Saini et al, around 76% of the patients had Vit D deficiency and 16% had insufficient Vit D. These values were higher than that of our study. Another study by Gallacher et al observed 82% to have vitamin D levels less than 70nmol/l and 72% below 50nmol/l.²⁹ Another study reported about 75% of the patients with the serum 25OHD <50 nmol/l and 68% with 25OHD of <30nmol/l.³¹ The Vitamin D levels show regional variation. It has reported to be 36% in Finland,^{32,33} around 50-80% in the US,^{34,35} 40-70% in Britain,³⁶ as high as 90% in Japan.^{37,38}

Most of the fragility fractures in our study (60.5%) involved the hip. Others involved vertebrae, wrist and humerus. Hip fractures were the most common type of fragility fractures. In a study by Saini et al, 51% of the patients had hip fractures.²⁸

Studies have shown that Vitamin D, when administered alone does not have any affect in the prevention of fractures, but when given with calcium as a supplement, there is definitely a positive response.^{39,40} Studies have shown that there was a significant difference between the persons who were on Vit D and Calcium supplementation to those without.²⁸

It has been reported that elderly patients who have been given high doses of vit D and calcium supplements are at lower risk of falls and fractures.⁴¹ This is because the Vit D is associated with the increase in muscle mass and strength. So a reduction in the vit D levels, would result in lower muscle strength and bone mass.^{42,43} This muscle weakness is reversible, when Vit D is supplemented.⁴⁴

5. Conclusion

Most of the patients were either had insufficient or deficient Vitamin D level at the time of their fall. Therefore, after the onset of menopause and especially in the elderly, it is imperative to keep a watch on the vitamin D levels and supplement calcium and vitamin D in medications so that the risk of fall is reduced. This will further reduce the morbidity, quality of life and cost of hospitalization of the patients.

6. Source of Funding

None.

7. Conflict of Interest

None.

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