



“EVALUATION OF VITAMIN D LEVELS IN PROXIMAL FEMUR FRACTURES”

Orthopaedics

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ABSTRACT

Introduction: Management of fractures of the proximal femur is always a challenging problem to deal with as they are very frequently associated with multiple injuries, leading to complications. Most of these fractures result as a result of fall in elderly which has been linked to the levels of vitamin D. Vitamin D has a significant role to play in the bone metabolism and neurovascular function.

Material and methods: A prospective study of 50 patients with proximal femur fractures, of age more than 50 years was carried out in our hospital. Patients with any concomitant pathology of the hip, liver and renal disease, gastrointestinal disorder were not included. Serum vitamin D levels of these patients were evaluated and compared according to their age and sex.

Results: In our study, 92% patients had hypovitaminosis D. Further, we found that there was no significant association of vitamin D levels with age and sex of our patients with proximal femur fractures.

Conclusion: We conclude that most of the elderly patients with proximal femur fractures have low vitamin D levels and it may be a definitive risk factor for its occurrence. Hypovitaminosis D is more common in females but we found no significant correlation between vitamin D levels and age and sex of the patients.

KEYWORDS

Introduction:

Proximal femur fractures are the most commonly occurring fractures and majority of these patients (90%) are aged above 50 years.² The incidence of these fractures is 2-3 times more in females as compared to the male population.² Proximal femur fracture risk in the elderly is a function of multiple factors, including BMD, muscle strength, and balance, all of which have been related to vitamin D status and function.^{18,19} Advanced age, female sex, osteoporosis, Caucasian race, smoking, alcoholism, previous fracture, vitamin D deficiency, history of fall and low estrogen level are the main risk factors for the occurrence of these type of fractures.²⁰ Chronic vitamin D deficiency in adult's results in osteomalacia, osteoporosis, muscle weakness and increased risk of falls.

Vitamin D deficiency is a pandemic and is the most under diagnosed and under treated nutritional deficiency in the world.^{26,27,28} Its deficiency exists in epidemic proportions all over the Indian subcontinent. Even though the majority of the Indian population resides in the areas receiving ample sunlight throughout the year, still vitamin D deficiency is a problem of growing concern.^{29,30}

In India, vitamin D deficiency is prevalent due to several factors namely changing food habits, high fibre diet containing phosphates and phytates, genetic factors, cultural and traditional habits like Burkha and pardah, repeated and unplanned pregnancies in dietary deficient patients which can aggravate its deficiency in the mother and the fetus.³¹

Serum 25-hydroxyvitamin D is the generally accepted indicator of vitamin D status. The most well-known function of 1,25(OH)₂D is regulation of calcium and phosphorus balance for the mineralization and remodelling of bone. If levels of 1,25(OH)₂D in the bloodstream are inadequate then dietary calcium cannot be absorbed. Further, if calcium levels are low then there is an increase in serum PTH concentration, leading to the increased tubular reclamation of calcium in kidneys and resorption from the skeleton at the cost of lowering bone density.

Patients who have lower vitamin D levels have slower walking time and often take a long time to stand up³⁴. In nine out of ten instances, proximal femur fractures are sustained through a fall,³⁷ and risk of falling have been related to vitamin D status.³⁸ It has been shown that elderly people with low calcium and vitamin D levels are at risk of falls and fractures owing to myopathy caused by vitamin D deficiency and secondary hyperparathyroidism.³⁹⁻⁴⁴ Thus, vitamin D is crucial for intestinal calcium absorption and for maintaining calcium homeostasis and skeletal integrity.⁴⁵ In view of the correlation of proximal femur fractures with osteoporosis, and the implication of deficiency of vitamin D in the prevention of osteoporosis, it was decided to study the correlation of vitamin D in patients with proximal femur fractures.

Material and methods: This is a prospective hospital-based study in 50 patients of age more than 50 years, with proximal femur fracture who presented to our hospital. Equal number of male and female patients were taken (25 each). Patients were further divided into two groups as per their age, one 50-64 years and another above 64 years of age.

Out of 50 patients 21 were between 50-64 years of age while 29 patients were more than 64 years of age. fall was the cause of fracture in 35 patients (13 male and 22 female) while 15 patients sustained a proximal femur fracture due to road traffic accident. 31 patients sustained fracture in their left side and remaining 19 on their right side. out of total 50 patients with proximal femur fracture 28 sustained inter-trochanteric fracture, 16 patients sustained neck of femur fracture and only 6 patients sustained sub-trochanteric fracture. All patients were initially treated with I/V fluids, analgesics and traction. Complete blood count along with serum vitamin D, serum calcium and alkaline phosphatase were sent for testing.

Technique of testing serum vitamin D: Chemiluminescence Immunoassay (CLIA) of vitamin D estimation

At our facility, vitamin D testing is carried out using CLIA technology in a fully automated analyzer Advia Centaur. CLIA is a quantitative immunoassay method used for the determination of 25(OH)D in serum

or plasma on a fully automated platform. It is a highly sensitive technology in which a specific antibody to vitamin D is used for coating magnetic particles (solid phase) and vitamin D is linked to an iso-luminol derivative. During incubation, 25-hydroxy vitamin D dissociates from its binding proteins and competes with the labelled vitamin D for binding sites on the antibody. After incubation, the unbound material is removed, with a wash cycle. Subsequently, starter reagents are added and a flash chemiluminescent reaction is initiated. The light signal is measured by a photomultiplier as a relative light unit and is inversely proportional to the concentration of 25-hydroxyvitamin D present in the samples. Advantages of this method include high specificity, high sensitivity, high reproducibility, cost effective and can be used in a small sample size.

Vitamin D levels were classified as deficient (<20ng/ml), insufficient (20-30ng/ml) and sufficient (>30ng/ml) according to the Horlick classification.³³ Patients were also assessed according to their sun exposure. According to FAO/WHO, expert consultation patients were divided into two groups (adequately exposed, inadequately exposed).⁹⁹

Statistical Analysis: Nominal data (such as gender, complications) was presented as number and percentages. Continuous data (such as age, ALP, Vitamin D) was expressed as mean, standard deviation and range. Unpaired T-test was applied as appropriate for comparison of nominal data. A P value of ≤0.05 was as considered as statistically significant.

Results: Out of total 50 patients (25 male and 25 female), average serum vitamin D levels in males and female patients was 21.95 ± 9.36 ng/ml and 17.87 ± 5.28 ng/ml respectively. (p=0.06) (Table 1)

Table 1: Relationship between sex and vitamin D levels.

Sex	No. of patients (n)	Avg. Vitamin D levels (ng/ml)	P value
Male	25	21.95 ± 9.36	0.06
Female	25	17.87 ± 5.28	

Our study also found that elderly patients had low serum vitamin D levels. We found that serum vitamin D levels in patients between age 560-64 years and patients above 50 years of age were 20.77±6.32 ng/ml and 19.73±8.43 ng/ml respectively. (p=0.837) (Table2)

Table 2: Relationship between age and vitamin D levels.

Age group (Years)	No. of patients (n)	Avg. vitamin D level (ng/ml)	P value
50-64 years	21	20.77±6.32	0.837
>64 years	29	19.73±8.43	

In this study, out of total 50 patients, 42% patients had vitamin D deficiency, 50% had inadequate vitamin D levels and 8% patients were vitamin D deficient. Among patients who had vitamin D levels less than 20ng/ml, around 67% patients were above 64Yrs of age, while 33% patients were between 50-64Yrs of age. On the other hand, 52% patients above 64Yrs of age had insufficient vitamin D levels compared to 48% patients who were between 50-64Yrs of age. (Table 3)

Table 3: Levels of Vitamin D in different age groups.

Vitamin D levels (ng/ml)	Age group (Years)		Total
	50-64Yrs (n=21)	>64Yrs(n=29)	
Deficient (<20ng/ml)	7(33%)	14(67%)	21 (42%)
Insufficient (20-30ng/ml)	12(48%)	13(52%)	25 (50%)
Normal (>30ng/ml)	2(50%)	2(50%)	4 (8%)
Total	21	29	50 (100%)

Table 4: Vitamin D levels in different sex.

Vitamin D levels (ng/ml)	Number of Patients		Total (n=50)
	Males (25)	Females (25)	
Deficient (<20ng/ml)	8 (38%)	13 (62%)	21(42%)
Insufficient (20-30ng/ml)	13 (52%)	12 (48%)	25(50%)
Normal (>30ng/ml)	4 (100%)	0 (0%)	4(8%)
Total	50(100%)		

Further comparing these levels in male and female patients, we found

that among patients who had vitamin D deficiency, 62% were females and 38% males. Vitamin D levels were insufficient in 52% of the males and 48% of the females. Among patients who had normal vitamin D levels, all were males. (Table 4)

On evaluation we found that only 23 patients in our study had adequate sunlight exposure while remaining 27 patients had inadequate sunlight exposure. For evaluation of sunlight exposure, we used the criteria given by FAO/WHO expert consultation 99. (p=0.03) (Table 4)

Table 5: Relationship between sunlight exposure and vitamin D levels.

Sunlight Exposure	Number of patients	Average vitamin D level (ng/ml)	P value
Adequately exposed	23 (46%)	22.50±8.80	0.03
Inadequately exposed	27 (54%)	17.70±5.55	
Total	50 (100%)	19.91±7.47	

Discussion: Proximal femur fractures in elderly are common in Orthopedic practice. Most of them are associated with osteoporosis. Vitamin D deficiency has been implicated in the causation of osteoporosis in these patients. In view of this, it was decided to carry out a study where the relationship of vitamin D with proximal femur fractures was studied.

In our study, a total of 50 consecutive patients, age >50Yrs with proximal femur fractures were selected as per the inclusion and exclusion criteria.

Our study found that 46 (92%) of our patients had abnormal vitamin D levels. Out of this 21 (42%), patients had vitamin D deficiency and 25 (50%) patients had insufficiency. We also found that vitamin D deficiency (levels<20ng/ml) was more prevalent in females and elderly (>64Yrs) age group (Table 3 & 4). Like us, many other studies have shown abnormally low Vitamin D levels.^{186,191} Maclaughlin J et al¹⁸⁸ in a study concluded that ageing is associated with a decrease in the 7-DHC concentrations in the skin, resulting in a reduction by more than 4 fold vitamin d production in a 70Yrs old compared with a 20Yrs sold adult. A study from Finland by Hoikka et al.¹⁹¹ has shown insufficient vitamin D levels in patients with proximal femur fractures respectively. Similar results have also been reported by an Indian study of Rajesh et al¹⁸⁶. The levels of Vitamin D in patients with proximal femur fracture were found to be lower as compared to controls in two different studies by Sakuma et al¹⁸⁷ and Bakthiaroviya et al.¹⁹¹

Since osteoporosis is more prevalent in females, we decided to compare Vitamin D levels among males and females. Though in our study female patients had lower vitamin D levels (17.87 ± 5.28) as compared to males (21.95 ± 9.36), this decrease was found to be statistically significant (p =0.06) (Table 1). Similar results were found by Simonelli C et al.¹⁷⁹ who in a study found that average vitamin D levels were low in patients with proximal femur fractures but there was no significant correlation between vitamin D levels and age and sex of the patients. Another study by Guerra et al¹⁸⁰ found that vitamin D levels in the fracture group were lower in females as compared to the males in the fracture group. Another study by Sharma V et al.¹⁸⁵ reported that postmenopausal women with fractures had low serum vitamin D levels. Labronici et al.¹⁸² when assessing fractures in postmenopausal women found that 82% of the patients had low 25(OH)D levels.

We divided our patients into two age groups (50-64Yrs & >64yrs) to evaluate if there is any correlation between age and Vitamin D levels in patients with proximal femur fractures. Though there was an average decrease of Vitamin D levels in patients of higher age group (19.73±6.32 vs 20.77±8.43ng/ml), this was found to be statistically non-significant (p=0.837) (Table 2). Similar results were obtained in a study by Guerra et al.¹⁸⁰ who studied vitamin D levels in 341 patients with proximal femur fractures and distributed them according to different age groups. They found that there were no significant differences between the age groups regarding the serum levels of 25(OH)D for the age ranges of 60–65 years (p = 0.327), 66–70 (p = 0.417), and 76–80 (p = 0.095). Another study by Simonelli C et al.¹⁷⁹ reported that mean vitamin D levels in elderly patients with proximal femur fractures are low but they were not significantly associated with age and sex of the patients. In our present study, a division according to

the age of the patients was made in order to discriminate the risk in certain age groups. However, no other studies with this methodology were retrieved, hindering a proper comparison.

In the present study, 84% of the females patients were inadequately exposed to sunlight while 76% males were adequately exposed to sunlight (Table 5). This may be because most the female patients in our study were Muslims and all of them practised wearing Burkhas. The average vitamin D levels in patients who were adequately exposed to sunlight were 22.5 ± 8.80 ng/ml while average vitamin D level in patients who were inadequately exposed was 17.70 ± 5.55 ng/ml ($p=0.03$). Thus, in our study, we found a statistically significant relationship between sunlight exposure and average vitamin D levels of patients with proximal femur fractures. Moreover, in our study average vitamin D levels were slightly lower in Muslim patients as compared to the patients of other religions but this was found to be statistically insignificant. We also found that out of the total (25) female patients, 44% females practised burkha and all had abnormal levels of vitamin D. Mean vitamin D levels in patients who practised burkha were 17.05 ± 5.45 ng/ml while in patients who did not practice burkha the levels were 18.51 ± 5.45 ($p=0.51$) (Table 17). Alagöl et al.¹⁰² in a study of 48 females found that patients who wore Islamic dresses and thus were inadequately exposed had lower levels vitamin D.

Conclusion: Proximal femur fractures in the elderly have always been a major concern for us due to its associated morbidity and mortality. Association between vitamin D levels and proximal femur fractures has always been a hot topic of debate. In our study of 50 consecutive patients with proximal femur fractures and age above 50yrs, almost all patients (92%) were suffering from hypovitaminosis D (vitamin D levels <30 ng/ml). We also found that 42% of our patients had vitamin D deficiency (Vitamin D levels < 20 ng/ml), 50% had insufficient levels (20-30ng/ml) only 8% patients had normal; vitamin D levels (>30 ng/ml). Even though there was decrease in the vitamin D levels in a vast majority of our patients, we were unable to find any significant association between vitamin D levels when patients of various age groups (50-65yrs vs above 65 years), sex (male vs female). However, there appears to be a significant association of sunlight exposure with vitamin D levels.

Thus, our study showed that vitamin D levels are lower in patients with proximal femur fractures. If the cause and effect relationship between Vitamin D and proximal femur fractures is established by larger double-blind multicentric trial, correction of the levels of Vitamin D in these elderly patients may very well lead to a decrease in the burden of disease in the community thereby leading to a windfall socio-economic gain.

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