

VITAMIN D STATUS AND ITS EFFECT ON FUNCTIONAL OUTCOME IN PATIENTS WITH HIP FRACTURE: AN OBSERVATIONAL STUDYKARAN HINGANKAR, AVINASH KEDARI, RAJ PRAMOD GANDHI, RAHIL JIWANI*^{id}

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ABSTRACT

Objectives: The study aimed to study the Vitamin D status of adult patients presenting with hip fractures and analyze potential impact of Vitamin D status on outcome of these patients.

Methods: This was an observational study of Vitamin D status of patients presenting with hip fractures. It was conducted in the department of orthopedics of a tertiary care medical college. One hundred and twenty adult patients presenting with hip fractures were included in this study on the foundation of a predefined inclusion and exclusion criteria. Demographic details of all the patients such as age, gender, and socioeconomic status were noted. Vitamin D status of patients was determined and correlated with functional outcome at the time of final follow-up visit at 6 months.

Results: Among the 120 studied with hip fractures, 64 cases (53.33%) involved females, while 56 cases (46.67%) involved males having a M: F ratio of 1:1.14. The mean age of male and female patients was found to be 45.85±10.12 and 46.74±9.86 years. Overall, 65 (54.17%) patients were Vitamin D sufficient and remaining 55 (45.83%) were either inefficient (26.67%) or deficient (19.17%). Seventy-three (60.83%) patients had excellent to good outcome whereas 31 (25.83%) patients had fair outcome. Out of remaining 16 patients, 11 (9.17%) patients had poor outcome and 5 (4.17%) patients had very poor outcome. The patients with sufficient Vitamin D status were found to have a better outcome as compared to those patients with inefficient or deficient Vitamin D status and the difference was found to be statistically significant (p=0.01).

Conclusion: It is significant to treat Vitamin D deficiency in patients presenting with hip fractures as Vitamin D deficiency is associated with suboptimal functional outcome in cases with hip fractures.

Keywords: Hip fractures, Modified Harris hip score, Vitamin D, Functional outcome.

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INTRODUCTION

Hip fractures, such as femoral neck fracture and intertrochanteric femur fractures, are a significant health concern, particularly among the elderly population and it is one of the common causes for which orthopedic consultations are sought. Hip fractures are associated with augmented morbidity and mortality as well as health-care costs [1]. The incidence of hip fractures is projected to rise as the global population ages, making it imperative to identify modifiable risk factors that could aid in prevention and improved outcomes. Various risk factors such as smoking, obesity, postmenopausal age, and neurological diseases such as Parkinson's disease and Vitamin D deficiency are recognized to be associated with increased risk of hip fractures. Irrespective of the predisposing factors the common causes of hip fractures include road traffic accidents or fall from height in relatively young patients and trivial trauma such as fall on the ground in elderly patients [2].

Vitamin D, traditionally recognized for its role in calcium homeostasis and skeletal health, has garnered increasing attention for its potential influence on fracture risk and recovery [3]. The active form of Vitamin D, calcitriol, plays a key role in enhancing intestinal calcium and phosphate absorption, thereby ensuring optimal mineralization of bone tissue. Moreover, emerging research has unveiled the presence of Vitamin D receptors in various extraskeletal tissues, indicating its broader physiological impact beyond bone health [4]. The association between Vitamin D deficiency and musculoskeletal disorders, including osteoporosis and fractures, has been extensively explored. Vitamin D lack can lead to secondary hyperparathyroidism, resulting in increased bone turnover and reduced bone mineral density. Consequently, bones become more susceptible to fractures, particularly in areas such as the hip, which are already prone to biomechanical stress [5].

Despite its pivotal role, Vitamin D deficiency remains a prevalent issue globally. Several factors contribute to inadequate Vitamin D levels, including limited sunlight exposure, age-related decline in skin synthesis, and dietary insufficiency. The elderly population, often confined indoors and at a higher risk of falls, is especially susceptible to Vitamin D deficiency and its subsequent effects on bone health. Vitamin D deficiency is also seen in patients with chronic renal and hepatic diseases [6].

Given the potential implications of Vitamin D status on fracture risk and recovery, investigating the Vitamin D status of patients with hip fractures becomes paramount. Hip fractures pose a considerable burden on both individuals and health-care systems worldwide [7]. Vitamin D, with its intricate involvement in skeletal health and potential non-skeletal effects, holds promise as a modifiable factor in mitigating fracture risk and optimizing recovery. Multiple studies are being undertaken to contribute to the growing body of knowledge regarding the role of Vitamin D in orthopedic health, with implications for enhancing clinical strategies aimed at improving patient outcomes after hip fracture [8].

This study goals to assess the prevalence of Vitamin D deficiency among patients presenting with hip fractures and to explore the potential impact of Vitamin D status on post-fracture outcomes. By elucidating the relationship between Vitamin D and hip fractures, we can potentially identify strategies for intervention and management that extend beyond the conventional scope of fracture care.

Aims and objectives

The objectives of the study are as follows:

1. To study the Vitamin D status of adult patients presenting with hip fractures
2. To analyze potential impact of Vitamin D status on outcome of patients.

METHODS

This was an observational training conducted in the department of orthopedics of a tertiary care medical college. One hundred and twenty adult patients presenting with hip fractures remained included in this study on the basis of a predefined inclusion and exclusion criteria. Keeping power (1-Beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 80 patients; therefore, we included 120 (more than minimum required number of cases) patients in this study.

Demographic details of all the patients such as age, gender, and socioeconomic status were noted. A detailed history was asked to ascertain the mechanism of injury such as history of road traffic accidents or falls. In old age patients, the presence of neurological diseases such as Parkinson's or Alzheimer's diseases was also asked and noted. X-ray findings of all the patients were reviewed. If further imaging studies such as computerized tomography had been done, then computerized tomography reports were also reviewed. The fractures were classified as per Garden's classification of hip fractures into incomplete fractures (Type I), complete and undisplaced fractures (Type II), complete and partially displaced fractures (Type III), and complete fracture with total displacement (Type IV) [9]. In all patients' findings of investigations such as complete blood count, C-reactive protein, and 25 (OH) Vitamin D levels were reviewed. For the purpose of diagnosis of Vitamin D status of the patients, 25 (OH)D levels above 30 ng/mL were considered to be normal whereas Vitamin D insufficiency and deficiency were diagnosed if 25 (OH) Vitamin D levels were between 20 and 30 ng/mL and below 20 ng/mL, respectively. Renal function tests (Blood urea then serum creatinine levels) and Hepatic function test (Serum Bilirubin, SGOT, and SGPT) were also reviewed as renal and hepatic dysfunction is one of the causes of secondary Vitamin D deficiency. Patients remained followed up at 6 and 12 weeks and finally at 6 months for functional outcome as determined by modified Harris hip score [10]. All patients were assessed for complications such as non-union, malunion, and osteonecrosis. Function outcome and incidence of complications were correlated with Vitamin D status of the patients.

Statistical analysis was performed with SPSS version 21.0. Quantitative data remained presented as mean and standard deviation. Qualitative data were obtainable with frequency and percentage tables. For quantitative data, unpaired t-test was applied and for qualitative data, Chi-square test was applied. $p < 0.05$ remained taken as statistically significant.

Inclusion criteria

The following criteria were included in the study:

1. Adult patients admitted to the orthopedic department with hip fractures
2. Age more than 18 years
3. Patients gave consent to be part of study.

Exclusion criteria

The following criteria were excluded from the study:

1. Those patients who refused consent
2. Age of the patients <18 years
3. Patients having polytrauma or multiple fractures
4. Patients with serious systemic illnesses such as uncontrolled diabetes or hypertension
5. Patients with pre-existing musculoskeletal disorders such as rheumatoid arthritis, psoriatic arthropathy, and scoliosis.

RESULTS

Among the 120 studied with hip fractures, 64 cases (53.33%) involved females, while 56 cases (46.67%) involved males having a M: F ratio of 1:1.14. The most common affected age group was found to be above 50 years (45.83%) followed by 41-50 years (33.33%). Sixteen (13.33%) affected patients were between 31 and 40 years whereas 9 (7.50%) patients were below 30 years of age. The mean age of male and female

patients was found to be 45.85 ± 10.12 and 46.74 ± 9.86 years. The mean age of male and female patients was originated to be comparable with no statistically significant difference ($p = 0.627$) (Table 1).

The analysis of the patients on the basis of mechanism of injury showed that road traffic accidents (61.67%) followed by fall from height (21.67%) were the most common causes of hip fractures. Trivial trauma and fall on the ground were cause of hip fracture in 12 (10%) and 5 (4.17%) patients, respectively. In 3 (2.50%) assault was the cause of hip fracture (Fig. 1).

Fractures were classified on the basis of Garden's classification of hip fractures. The most common type of fracture seen was complete and partially displaced fracture (Type III) which was seen in 68 (56.67%) patients followed by complete and undisplaced fractures (Type II) which was seen in 28 (23.33%) patients. Incomplete fractures (Type I) were seen in 18 (15.00%) patients whereas complete fracture with total displacement (Type IV) were seen in 6 (5.00%) patients (Table 2).

The Vitamin D status of patients presenting with hip fractures was determined and patients were divided to be either Vitamin D sufficient, inefficient, or deficient on the basis of serum vitamin D levels. Overall, 65 (54.17%) patients were Vitamin D sufficient and remaining 55 (45.83%) were either inefficient (26.67%) or deficient (19.17%) (Table 3).

After surgical treatment, patients were followed up to 6 months for functional outcome as assessed by Modified Harris hip score. Out of 120 studied cases, 73 (60.83%) patients had excellent to good outcome whereas 31 (25.83%) patients had fair outcome. Out of remaining 16 patients, 11 (9.17%) patients had poor outcome and 5 (4.17%) patients had very poor outcome (Fig. 2).

The functional outcome of the patients was correlated with Vitamin D status. Out of 65 (54.17%) patients having sufficient Vitamin D

Table 1: Age and gender distribution of the studied cases

Age in years	Gender distribution			
	Males		Females	
	No	%	No	%
<30 years	4	3.33	5	4.17
31-40 years	7	5.83	9	7.50
41-50 years	19	15.83	21	17.50
Above 50 years	26	21.67	29	24.17
Total	56	46.67	64	53.33
Mean age (in years)	46.74±9.86		45.85±10.12	
p-value	p=0.627 (not significant)			

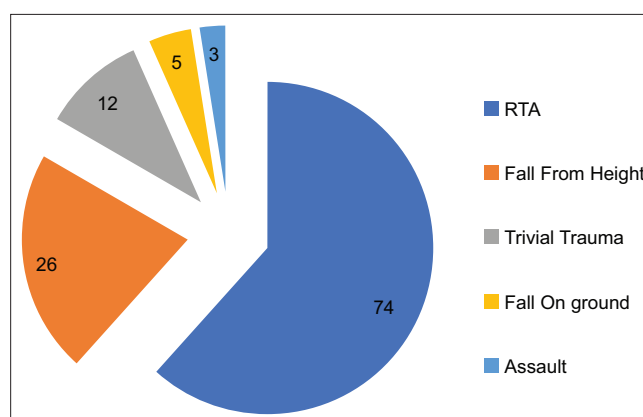


Fig. 1: Mechanism of injury in cases of patients presenting with hip fractures

levels, 61 (50.83%) patients had excellent or fair outcome whereas 4 (3.33%) had either poor or very poor outcome. Among 55 (45.83%) patients found to have either inefficient or deficient Vitamin D levels 43 (35.83%) patients had excellent to fair outcome and 12 (10%) patients had poor or very poor outcome. The patients with sufficient Vitamin D status were found to have a better outcome as compared to those patients with inefficient or deficient Vitamin D status and the difference was found to be statistically significant (p=0.01) (Table 4).

DISCUSSION

In this study of Vitamin D status in 120 patients presenting with hip fractures, we found that there was a male preponderance with a M: F ratio of 1:1.14. The mean age of male and female patients was found to be

46.74±9.86 and 45.85±10.12 years. Female preponderance in cases of hip fractures has been reported by many studies. Alpantaki et al. conducted a 9-year, retrospective, and cohort study to investigate the differences in distribution of intracapsular and extracapsular hip fractures amid genders and age groups preserved surgically [11]. Women suffered hip fractures 2.9 times more repeatedly than men. The majority of patients hospitalized with hip fracture remained above 75 years of age (62.3% in females and 59.3% in males). Similar male preponderance was also reported by the authors such as Hawkes et al.[12] and Orwig et al. [13]

In our study, road traffic accidents followed by fall from height were the most common causes of hip fractures. Trivial trauma and fall on the ground were cause of hip fracture in 12 (10%) and 5 (4.17%) patients, respectively. George et al. conducted a study to analyze injury patterns of hip fractures in India [14]. The study found that the mechanism of injury for the majority of patients was either fall from a standing height or road traffic chance. Slipping on a wet floor (n=49, 22.6%) and alteration in posture (n=35, 16.1%) were the most commonly reported reasons for falling. The first two major causes of injury, that is, road traffic accidents and fall from height were similar to our study. Similar injury patterns were also reported by the authors such as Endo et al. [15] and Moayyeri et al. [16]

The main purpose of our study was to determine the Vitamin D status of the patients presenting with hip fractures and to correlate Vitamin D levels of the patients with functional outcome. In this study, out of 120 studied cases, 65 (54.17%) patients were Vitamin D sufficient and remaining 55 (45.83%) were either inefficient (26.67%) or deficient (19.17%). Ramason et al. conducted a study to find out status of Vitamin D in patients with hip fractures for this purpose the authors determined Vitamin D status of 485 patients with hip fracture admitted to the orthopedic department [17]. The study found that Vitamin D deficiency was present in 57.5% (n=237). The prevalence of Vitamin D insufficiency remained 34.5%, through only 8% of patients having usual Vitamin D levels. Although in our study, a relatively higher number of patients had normal Vitamin D level; however, significant number of patients were having Vitamin D inefficiency or deficiency. Similar Vitamin D profile of the patients presenting with hip fractures was also reported by the authors such as Bischoff-Ferrari et al. [18] and Khadgawat et al. [19]

The analysis of patients on the basis of outcome showed that 73 (60.83%) patients had excellent to good outcome whereas 31 (25.83%) patients had fair outcome. Out of remaining 16 patients, 11 (9.17%) patients had poor outcome and 5 (4.17%) patients had very poor outcome. The correlation between Vitamin D levels and outcome showed that patients with sufficient Vitamin D status were found to have a better functional outcome as compared to those patients with inefficient or deficient Vitamin D status and the difference was found to be statistically significant (p=0.01). In a similar study, Ingstad et al. found that Vitamin D status of the patients significantly affects the outcome of patients. The study found that low Vitamin D at admission for hip fracture increased the risk of delirium, a new hip fracture, and medical readmissions [20].

Limitation of the study

This was a purely observational study. Further randomized and controlled trials are wanted to substantiate the findings of this study.

CONCLUSION

Vitamin D deficiency is found to have an adverse impact on functional outcome of patients with hip fracture; hence, it is important to determine Vitamin D status of patients so that appropriate Vitamin D supplementation can be given in cases of hip fracture who have concurrent Vitamin D deficiency.

AUTHOR CONTRIBUTION

KH- Concept and design of the study, interpreted the results, ready first draft of manuscript, and critical revision of the manuscript;

Table 2: Distribution of cases according to Garden's classification of hip fractures

Type of fracture	No of patients	Percentage
Incomplete fractures (Type I)	18	15.00
Complete and undisplaced fractures (Type II)	28	23.33
Complete and partially displaced fractures (Type III)	68	56.67
Complete fracture with total displacement (Type IV)	6	5.00
Total	120	100.00

Table 3: Comparison of Vitamin D status in both groups

Vitamin D status 25(OH) vitamin D levels	No of cases	Percentage
Sufficient (>30 ng/mL)	65	54.17
Inefficient (20-30 ng/mL)	32	26.67
Deficient (<20 ng/mL)	23	19.17
Total	120	100.00

Table 4: Correlation of Vitamin D levels with functional outcome in studied cases

Vitamin D status 25 (OH) vitamin D levels	Excellent to fair outcome	Poor or very poor outcome
Sufficient (>30 ng/mL)	61	4
Inefficient/Deficient (30 or <30 ng/mL)	43	12
Total	104	16

p=0.01 (statistically significant)

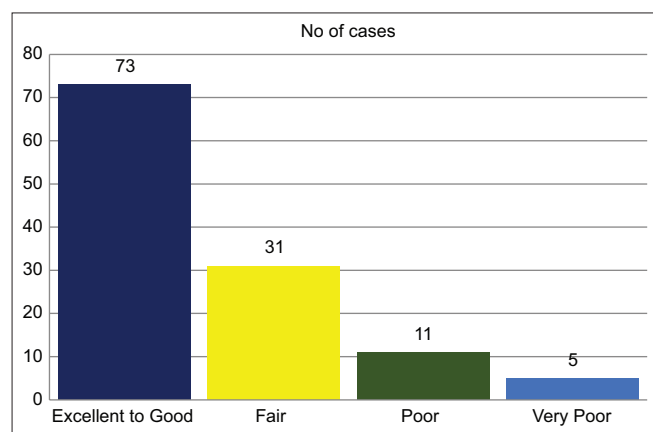


Fig. 2: Functional outcome of studied cases

AK- Statistically analyzed and interpreted, reviewed the literature, and manuscript training; RG- Design of the study, statistically analyzed and interpreted, preparation of manuscript, and amendment of the manuscript; and RJ- Concept and coordination of the overall study

CONFLICTS OF INTEREST

None.

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