Evaluation of the Prevalence of Vitamin D Deficiency in Postmenopausal Women with Fractures in Different Hospitals in Tangail

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Abstract

Background: Vitamin D deficiency is common among the post-menopausal women and the prevalence of vitamin D deficiency is high in postmenopausal women with fractures regardless of whether the injury mechanism was high or low energy. Objective: To evaluate the prevalence of vitamin D deficiency in postmenopausal women with fractures that revealed a high prevalence of vitamin D deficiency regardless of whether the injury mechanism was high or low energy. Methodology: The study was a cross sectional observational study conducted in different hospitals in Tangail over a period of 2 years from 1st January 2017 to 31st December 2018. Total 150 postmenopausal women aged 50 years or older with long bone or pelvic fractures and measurements of serum vitamin D levels were included and those with pathological fractures, metabolic diseases such as Paget’s disease and hyperparathyroidism and isolated hand or foot fractures were excluded. Result: Majority 72 (61.0%) patients were found osteoporosis in low energy group and 12 (37.5%) in high-energy group. Median BMD at the total femur was found -2.1 in low energy group and -1.3 in high-energy group, which were statistically significant (p<0.05) between two groups. Calcium and vitamin D supplements after injury were statistically significant (p<0.05) within the low and high-energy group in comparison prior to the injury. Conclusion: Majority patients were found osteoporosis in low energy group in comparison to high-energy group. Calcium and vitamin D supplements after injury were statistically significant within the low and high-energy group compared with before injury. Keywords: Fracture, Vitamin D deficiency, Osteoporosis, supplementation.

INTRODUCTION

Vitamin D deficiency is common among post-menopausal women and it is important to treat vitamin D deficiency to prevent falls and fractures in patients with osteoporosis [1]. Vitamin D is a steroid hormone that affects human health. Vitamin D can be acquired from the diet, e.g., in fish oil or fortified dairy products, but approximately 90% of the body’s vitamin D is synthesized via skin after exposure to solar ultraviolet B (UVB) radiation [2]. Vitamin D deficiency is a risk factor for fall and fracture among post-menopausal women with osteoporosis and vitamin D deficiency is a pandemic health problem which was attributed for several health problems and well documented in different parts of the globe including Bangladesh [3,4]. Moderate level of sun exposure is the major source for Vitamin D as only limited dietary sources are rich in Vitamin D [5]. Vitamin D deficiency is known to result in osteopenia and osteomalacia, and to worsen osteoporosis [6]. It will also lead to muscle weakness, resulting in an increased fall risk, and corresponding risk of fractures [7]. Furthermore, the vitamin D status of adult patients with a long bone fracture affects the healing of fractures [8]. The fracture-healing process can be divided into four overlapping stages: inflammation, soft callus formation, hard callus formation, and bone remodeling [9]. Vitamin D is important in bone health, but recent research also points out its essential role in extra skeletal functions, including skeletal muscle growth, immune and cardiopulmonary functions and inflammatory modulation, which influence athletic performance. Vitamin D can also interact with extra skeletal tissues to modulate injury recovery and also influence the risk of infection [10]. The prevalence of vitamin D deficiency in postmenopausal women with fractures and revealed a high prevalence of vitamin D deficiency regardless of
whether the injury mechanism was high or low energy. However, the prescription rate of vitamin D supplementation was lower in the high-energy compared to the low-energy injury group [11].

**MATERIALS AND METHODS**

The study was a cross sectional observational study conducted in different hospitals in Tangail over a period of 2 years from 1st January 2017 to 31st December 2018. Postmenopausal women aged 50 years or older with long bone or pelvic fractures and measurements of serum vitamin D levels were included, and those with pathologic fractures, metabolic diseases such as Paget’s and hyperparathyroidism, and isolated hand or foot fractures were excluded. Postmenopausal status was obtained from medical records. The patients were divided into two groups according to the mechanism of injury: low-energy (118 patients) or high energy injury (32 patients). Low-energy injury was defined as falls from heights of 1 m or less. Measurement of 25-OH-Vitamin D3 was performed using radioimmunoassay (Bio Source Europe S.A., Nivelles, Belgium). Deficiency was defined as 0–20 ng/mL, insufficiency as 20–30 ng/mL, sufficiency as 30–150 ng/mL, and toxicity as 150 ng/mL or more. Bone turnover markers including serum osteocalcin, parathyroid hormone (PTH), C-telopeptide (CTX), Ca, P, alkaline phosphatase (ALP), and albumin were studied. Body mass index (BMI), history of prior osteoporosis medications, and prescription of osteoporosis medication after fracture was assessed. Bone mineral density (BMD) was measured with dual-energy x-ray absorptiometry (DEXA, Prodigy Advance, GE Healthcare Lunar, Madison, WI, USA) and BMD of the femoral neck, total hip area, and first to fourth lumbar vertebrae were recorded. Prevalence of vitamin deficiency was determined, and the rate was compared between the two groups, along with the postoperative prescription rate of vitamin D supplementation. Data were processed and analyzed using SPSS ver-23 (Statistical Package for Social Sciences). The test statistics used to analyze the data were descriptive statistics. The summarized data were presented in the form of tables.

**RESULT**

Majority 37(31.4%) patients were found femur injury in low energy group and 2(6.3%) in high energy group (Table-1). Mean age, BMI, C Terminal Telopeptide, osteocalcin, iPTH, calcium, phosphorus, alkaline phosphatase and albumin were not statistically significant (p>0.05) between two groups (Table-2). The mean vitamin D was found 23.2±9.3 ng/ml in low energy group and 21.7±9.4 ng/ml in high energy group. The difference was not statistically significant (p>0.05) between two groups (Table-3). Majority 72(61.0%) patients were found osteoporosis in low energy group and 12(37.5%) in high-energy group. Median BMD at the total femur was found -2.1 in low energy group and -1.3 in high-energy group which were statistically significant (p<0.05) between two groups (Table-4). In before injury, 19(16.1%) patients received treatment with calcium and vitamin D supplements in the low energy group and 1(3.1%) in high energy group. In after injury, 69(58.5%) patients were treatment received calcium and vitamin D supplements in the low energy group and 10(31.3%) in high energy group. The difference were statistically significant (p<0.05) between two groups. Calcium and vitamin D supplements- after injury were statistically significant (p<0.05) within the low and high energy compare with before injury (Table-5). In before injury, 22(18.6%) patients were treatment received osteoporosis supplementation in the low energy group and 1(3.1%) in high energy group. In after injury, 72(61.0%) patients were treatment received osteoporosis supplementation in the low energy group and 12(37.5%) in high energy group. The difference were statistically significant (p<0.05) between two groups. Osteoporosis supplement- after injury were statistically significant (p<0.05) within the low and high energy compare with before injury (Table-6).

| Table-1: Fracture site of the study patients |
|---------------------------------------------|
| Low energy (n=118) | High energy (n=32) |
|-------------------|-------------------|
| **n** | **%** | **n** | **%** |
| Humerus | 7 | 5.9 | 0 | 0.0 |
| Radius | 27 | 22.9 | 2 | 6.3 |
| Pelvic ring injury | 3 | 2.5 | 6 | 18.8 |
| Femur | 37 | 31.4 | 2 | 6.3 |
| Patella | 10 | 8.5 | 1 | 3.1 |
| Tibia | 4 | 3.4 | 8 | 25.0 |
| Multiple | 30 | 25.4 | 13 | 40.6 |
Table-2: Association between demographic characteristic and laboratory findings with injury mechanism

| Variable                              | Low energy (n=118) | High energy (n=32) | P value |
|---------------------------------------|-------------------|--------------------|---------|
| Mean±SD                               | Mean±SD           |                    |         |
| Age (years)                           | 69.7±10.2         | 66.4±9.3           | 0.101   |
| BMI (kg/m²)                           | 23.5±3.8          | 23.1±3.0           | 0.583   |
| C Terminal Telopeptide (ng/mL)        | 0.52±0.23         | 0.61±0.29          | 0.066   |
| Osteocalcin (ng/ml)                   | 14.8±8.9          | 15.9±8.6           | 0.450   |
| iPTH (pg/ml)                          | 49.4±24.5         | 44.7±21.3          | 0.324   |
| Calcium (mg/dl)                       | 7.9±0.7           | 8.0±0.8            | 0.488   |
| Phosphorus (mg/dl)                    | 3.3±0.7           | 3.2±0.9            | 0.503   |
| Alkaline phosphatase (U/L)            | 118.2±78.5        | 145.1±89.2         | 0.097   |
| Albumin (g/dL)                        | 3.1±0.5           | 3.2±0.4            | 0.298   |

P value reached from unpaired t-test

Table-3: Association between vitamin D with injury mechanism

| Vitamin D (ng/ml)              | Low energy (n=118) | High energy (n=32) | P value |
|-------------------------------|-------------------|--------------------|---------|
| n                             | %                 | n                  | %       |
| Normal (≥30)                  | 28                | 23.7               | 3       | 9.4   |
| Insufficiency (20.0-29.9)     | 21                | 17.8               | 6       | 18.8  |
| Deficiency (<20.0)            | 69                | 58.5               | 23      | 71.9  |
| Mean±SD                       | 23.2±9.3          | 21.7±9.4           | 0.421   |

P value reached from chi square test

Table-4: Association between bone mineral density with injury mechanism

| Bone mineral density           | Low energy (n=118) | High energy (n=32) | P value |
|-------------------------------|-------------------|--------------------|---------|
| n                             | %                 | n                  | %       |
| Normal (≥-1.0)                | 3                 | 2.5                | 9       | 28.1  |
| Osteopenia (-1.1 to -2.49)    | 43                | 36.4               | 11      | 34.4  |
| Osteoporosis (≤-2.5)          | 72                | 61.0               | 12      | 37.5  |
| Median BMD at the lumbar spine| -2.2              | -2.0               |         | 0.462 |
| Median BMD at the femur neck  | -2.2              | -1.9               |         | 0.143 |
| Median BMD at the total femur | -2.1              | -1.3               |         | 0.001 |

P value reached from chi square test & unpaired t-test

Table-5: Association between low calcium+ vitamin D medication with injury mechanism

| Calcium+ vitamin D medication   | Low energy (n=118) | High energy (n=32) | P value |
|-------------------------------|-------------------|--------------------|---------|
| n                             | %                 | n                  | %       |
| Before injury                 | 19                | 16.1               | 1       | 3.1   |
| After injury                  | 69                | 58.5               | 10      | 31.3  |
| P value (before vs after injury) | **0.001**         | **0.003**          |         |       |

P value reached from unpaired & paired t-test

Table-6: Association between osteoporosis medication with injury mechanism

| Osteoporosis medication        | Low energy (n=118) | High energy (n=32) | P value |
|-------------------------------|-------------------|--------------------|---------|
| n                             | %                 | n                  | %       |
| Before injury                 | 22                | 18.6               | 1       | 3.1   |
| After injury                  | 72                | 61.0               | 12      | 37.5  |
| P value (before vs after injury) | **0.001**         | **0.001**          |         |       |

P value reached from unpaired & paired t-test

**DISCUSSION**

Calcium and vitamin D deficiency may contribute to fracture healing complications observed in patients with osteoporosis [12, 13] because calcium is essential for fracture-callus mineralization [14]. Furthermore, it has been reported that among elderly patients with hip fractures, 80% had secondary causes for bone loss, mainly related to disturbed Ca and vitamin D homeostasis [15].

In current study observed that the majority 37(31.4%) patients were found femur injury in low...
energy group and 2(6.3%) in high energy group. Similar study reported by Lee and Kim [11].

In this study showed the mean age, BMI, C Terminal Telopeptide, osteocalcin, iPTH, calcium, phosphorus, alkaline phosphatase and albumin were not statistically significant (p>0.05) between two groups. Lee and Kim reported there was no difference in age between the low and high-energy groups [11]. BMI, serum calcium, phosphorus, PTH, osteocalcin, CTX, ALP and albumin were also similar between the two groups. Al-Yatama et al., reported bone turnover and mineralization are affected by vitamin D status such that vitamin D deficiency may lead to low BMD [16]. Reduced BMD, which is also known as osteopenia, may lead to osteoporosis and an increased risk of fracture if left untreated [17, 18]. Vitamin D deficiency is prevalent among patients with osteoporosis [19]. Supplementation with vitamin D and calcium has been shown to reduce the risk of hip fractures among elderly women [20]. Hannemann et al., also observed median (1st-3rd quartile) serum OC concentrations were 14.4 ng/mL (11.3-18.5 ng/mL) in premenopausal women and 18.6 ng/mL (13.6-25.6 ng/mL) in postmenopausal women [21].

In this study observed that the mean vitamin D was found 23.2±9.3 ng/ml in low energy group and 21.7±9.4 ng/ml in high energy group. The difference was not statistically significant (p>0.05) between two groups. Lee and Kim reported that the prevalence of vitamin D deficiency was 60.7% and 65.5% in the low and high-energy groups (p = 0.673), respectively [11]. This finding is consistent with the results of the 6th Korea National Health and Nutrition Examination Survey (KNHANES), which showed a prevalence of vitamin D deficiency of 74.2% in the general population [22]. In Bangladesh serum 25(OH)D <37.7 nmol/l was seen in 50% of those in low income groups (median 36.7 nmol/l) compared to 38% of high income groups (median 43.5 nmol/L). Prevalence of low 25(OH)D increased in lactating women [23]. Vitamin D insufficiency (<40 nmol/l) was common (80%) regardless of age, lifestyle and clothing in study from Dhaka [24].

In this study showed that the majority 72(61.0%) patients were found osteoporosis in low energy group and 12(37.5%) in high energy group. Median BMD at the total femur was found -2.1 in low energy group and -1.3 in high energy group. Which were statistically significant (p<0.05) between two groups. Lee and Kim study observed BMD was evaluated in 85.0% (91) of patients in the low energy group and 82.8% (24) in the high-energy group (p =0.441) [11]. The prevalence of osteoporosis (T-score ≤-2.5) was found to be higher in the low-energy group (62.6% vs. 37.5%, p = 0.024), BMD in the spine and femoral neck, however, were found to be similar between the two groups (p = 0.368, p = 0.067, respectively), but BMD in the total femur was lower in the low-energy group (p = 0.005). This practice is consistent with the National Osteoporosis Foundation (NOF) guidelines based on FRAX results for the US population, which suggest that treatment should be provided to patients with a 20% or greater 10-year risk of osteoporotic fracture or a 3% or greater 10-year risk of hip fracture [25]. Al-Yatama et al., regarding the direct relationship between vitamin D and BMD [2, 18, 19, 24, 27]. In addition, high levels of bone turnover markers in the blood may indicate increased bone loss [28]. A cross-sectional study revealed that patients with fractures had higher bone turnover marker levels than individuals without fractures [29]. It has been reported that women lose approximately 1% of their spinal bone density across the menstrual cycle and after menopause [30]. A cross-sectional investigation that included 635 healthy women of European descent demonstrated that those with the lowest bone mass had the highest levels of osteocalcin, NTX, CTX, and BALP [31].

In this study showed in before injury, 19(16.1%) patients were treatment received calcium and vitamin D supplements in the low energy group and 1(3.1%) in high energy group. In after injury, 69(58.5%) patients were treatment received calcium and vitamin D supplements in the low energy group and 10(31.3%) in high energy group. The difference were statistically significant (p<0.05) between two groups. Calcium and vitamin D supplements- after injury were statistically significant (p<0.05) within the low and high energy compare with before injury. Lee and Kim fifteen patients (14.0%) in the low-energy group were on Ca and vitamin D supplements prior to injury, compared to only one patient (3.4%) in the high-energy group (p = 0.100) [11]. The rate of postoperative Ca and vitamin D supplementation was higher in the low-energy group (85.0%, 91 patients) than the high-energy group (58.6%, 17 patients) (p = 0.003). In both groups, the prescription rates of calcium and vitamin D supplementation increased after the occurrence of fracture (p < 0.001, p < 0.001).

In current study showed in before injury, 22(18.6%) patients were treatment received osteoporosis supplementation in the low energy group and 1(3.1%) in high energy group. In after injury, 72(61.0%) patients were treatment received osteoporosis supplementation in the low energy group and 12(37.5%) in high energy group. The difference were statistically significant (p<0.05) between two groups. Osteoporosis supplement- after injury were statistically significant (p<0.05) within the low and high energy compare with before injury. Lee and Kim reported that the rate of osteoporosis treatment prior to injury was 18% in the low-energy group vs. 7% in the high-energy group (p = 0.123) [11]. Osteoporosis medication was generally prescribed more frequently in the low-energy group than in the high energy group (73.8% vs. 48%, p = 0.009). In both groups, the
prescription rates of osteoporosis medication increased after the occurrence of fracture (p <0.001, p <0.001).

CONCLUSION

Majority patients were found osteoporosis in low energy group in comparison to high energy group. Calcium and vitamin D supplements after injury were statistically significant within the low and high energy compare with before injury.

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