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Calcium and Vitamin D Supplementation in Elderly Patients with Hip Fractures

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A B S T R A C T

Hip fracture contributes to both morbidity and mortality in the elderly. Adequate levels of calcium and vitamin D are needed to ensure optimum effects of the treatments for osteoporosis. 41 elderly patients above the age of 60 years with low energy hip fractures were included into the study. After ascertaining the cognition levels, blood was collected from all the patients for the evaluation of Total calcium and vitamin D. One week after the operation, the diet of the patients was advised along with the intake of the calcium 1000mg/day for 12 weeks and vitamin D3 50,000IU/week for 8 weeks and 2000IU/day for next 4 weeks as supplements. The mean age for the men was 79.6 years and in women it was 75.7 years. The men were predominantly overweight, with 5 out of 12 patients and 2 were under weight. However, among the women, 11 out of 29 patients were overweight and 9 obese. The calcium levels in the males before supplements were 2.1 ± 0.9 mmol/l and in females it was 1.9 ± 0.3 mmol/l. This level increased to 2.4 ± 1.2 mmol/l and 2.2 ± 0.9 mmol/l respectively after three months of treatment with the supplements. Similarly, the vitamin D levels were 68 ± 23nmol/l in males and 71 ± 21nmol/l in females at base line which increased to 323 ± 41nmol/l and 329± 45nmol/l in males and females respectively after three months of treatment with the supplements. Calcium and vitamin D represents a correctable risk factor for fragility fracture in the elderly, possibly specifically for the hip.

Introduction

Osteoporosis is a major health problem, especially in elderly populations, and is associated with fragility fractures at the hip, spine, and wrist. Hip fracture contributes to both morbidity and mortality in the elderly. Because of its complications, which include chronic pain, disability, diminished quality of life, and premature death, this is considered to be one of the major health problems of the elderly in the West as well as a growing problem in Asia (Mithal *et al.*, 2009). With the life expectancy growing throughout the world, the number of the elderly persons is estimated to rise from 1.66 million in 1990 to 6.26 million by 2050 (Cooper *et al.*, 1992).

The incidence of hip fractures varies across the different countries of the world. It is found to be highest in Sweden and North America, while in the Asian and the Latin American

countries, it is found to be less. However, since the density of population is higher in Asia, by 2050, the incidence of hip fractures is estimated to contribute more than 50% in the world (Cooper *et al.,* 1992).

Half of all women will eventually suffer from a fracture after the age of 50, while the same is estimated to occur for 25% of all males at the same age (Keen *et al.,* 2007). Thus, the prevention of osteoporosis has become of utmost importance. It has been shown that identification and management of patients at risk can significantly reduce the risk of a further fracture through modification of life style, adequate treatment of osteoporosis, and a falls prevention programme (Fisher *et al.,* 2006; Parker.*et al.,* 2000). Most current osteoporosis guidelines assume that patients who receive treatment for secondary prevention of osteoporotic fragility fractures have an adequate calcium intake and are vitamin D replete. Adequate levels of calcium and vitamin D are needed to ensure optimum effects of the treatments for osteoporosis and are recommended in the data sheets of all the commonly used drugs.

Vitamin D status is best evaluated by measuring the circulating 25-hydroxyvitamin D concentration in the serum. A level of 75 nmol/L or above is the general accepted for optimal circulating 25-hydroxyvitamin D level (Bischoff-Ferrari *et al.,* 2004). Low calcium levels increase parathyroid hormone (PTH) production by the parathyroid glands. This stimulates calcium release from the bones and increases the reabsorption of calcium in the distal renal tubule cells. PTH also stimulates the renal production of biologically active vitamin D, which in turn increases calcium absorption from the gut. All these actions increase the calcium level in plasma. High calcium levels on the other hand stimulate the thyroid gland to produce and release calcitonin, which inhibits bone resorption by blocking PTH receptors on the osteoclasts, decreases calcium reabsorption in the kidney, and decreases calcium absorption from the gut. Thus reducing plasma calcium levels (Andy De Jong *et al.,* 2013).

Vitamin D deficiency may be characterized biochemically by the presence of secondary hyperparathyroidism, which can also contribute to the bone loss in osteopenic patients. Secondary hyperparathyroidism is a physiological response to hypocalcaemia associated with vitamin D deficiency, and treatment with vitamin D will normalise the elevated PTH levels without significantly elevating the serum calcium level(Andy De Jong *et al.,* 2013).In the general population, particularly in the elderly, vitamin D levels are commonly reduced as a result of low dietary intake, decreased sun exposure, decreased intrinsic vitamin D production, and decreased vitamin D receptor activity (Tangpricha *et al.,* 2002).

This study was conducted for the purpose of observing the levels of calcium and vitamin D levels before and after the treatment with supplements in elderly patients with hip fractures.

Materials and Methods

This study was conducted by the department of Biochemistry and Orthopedics of Anupama Hospital, Hyderabad during the period of One year. 41 elderly patients above the age of 60 years with low energy hip fractures who had come to our hospital for management were included into the study. The hip fractures for all of these patients were caused by fall from the same level as the patient.

After obtaining the clearance from the Institutional ethical committee, the details of the study were explained to the patients and Informed consent was obtained from all of

them. Patients with multifractures, fractures other than hip, patients under 65 years of age and high energy fractures were excluded from the study. Patients who were not cognitive or unable to communicate were also excluded from the study.

The cognitive function of the patients was assessed using the Mild-mental state examination (MMSE) questionnaire with 10 questions, including for orientation to time and place, repeating named prompts, registration recall, phrase repetition, drawing of interlocking figures etc. A total of 30 points was given to the questionnaire and any score greater or equal to 24 points indicated normal cognition (Folstein *et al.,* 1975).

Demographic details including the age, height, weight was noted for all the patients and the nutritional status was evaluated by calculating the body mass index. Blood was collected from all the patients used for the evaluation of serum Total calcium and serum vitamin D. Calcium was estimated using the o-cresolphthale in complex one method. Vitamin D was estimated using 25(OH) vitamin D ELISA (SIGMA) method.

One week after the operation, the diet of the patients was advised along with the intake of the calcium 1000mg/day for 12 weeks and vitamin D3 50,000IU/week for 8 weeks and 2000IU/day for next 4 weeks as supplemtents. Mean values for all the variables was calculated and student t test was performed to compare the means. A p value of <0.05 was considered to be significant.

Results and Discussion

Out of the 41 patients, 29 (70.7%) were women and 12 (29.3%) were men (Fig. 1). Cervical hip fractures was observed in 23 (56.1%) patients and trochanteric hip fractures was seen in 18 (43.9%) (Fig. 2).

The mean age for the men was 79.6 years and in women it was 75.7 years. The men were predominantly overweight, with 5 out of 12 patients and 2 were under weight. However, among the women, 11 out of 29 patients were overweight and 9 obese (Table 1).

The calcium levels in the males before supplements were 2.1 ± 0.9 mmol/l and in females it was 1.9 ± 0.3 mmol/l. This level increased to 2.4 ± 1.2 mmol/l and 2.2 ± 0.9 mmol/l respectively after 3 months of treatment with the supplements.

Similarly, the vitamin D levels were 68 ± 23nmol/l in males and 71 ± 21nmol/l in females at base line which increase to 323 ± 41nmol/land 329± 45nmol/l in males and females respectively after 3 months of treatment with the supplements (Table 2).

Vitamin D is a fat soluble and it controls the absorption of calcium from the intestines and its use in bone mineralization and also provides immunity (Harinarayan *et al.,* 2005). A lack of vitamin D leads to impaired mineralisation of bone, with the development of rickets in children or osteomalacia in adults apart from autoimmune disorders, cardiovascular disorders, various cancers, diabetes, hypertension, osteoporosis and fractures in bones (Holick *et al.,* 2005).

The recommended daily intake of vitamin D is 600 IU. About 90% of the daily recommended intake is obtained from the action of sunlight on the skin. Exposure of the face and arms for 20-30 minutes per day will be sufficient, although sunscreens of Factor 10 and above will block the synthesis of vitamin D by the skin. The remaining 10% of our vitamin D is supplied by diet. Good sources of vitamin D include fortified margarine and cereal, egg yolk and oily fish. During the winter months in the UK, vitamin D is only available from the diet, and there is

a risk of deficiency in those who have inadequate intake (Grant *et al.*, 2005).

Calcium is also essential for bone health. The Government's committee on the Medical Aspects of Food and Nutrition Policy (COMA), has recommend that the Reference Nutrient Intakes (RNI) for adults should be above 700mg/day to be compatible with bone health in the normal population. If a patient has been diagnosed with osteoporosis, calcium intake may be increased to approximately 1200mg/day for adults. Extra calcium levels may be taken as part of the diet or given as a supplement, although it is recommended that the daily intake from all sources should not exceed more than 2000-2500mg of calcium per day as higher levels may have a detrimental effect on health (MHSO, 1988). A general consensus of 1,200 mg/day levels of calcium may slow the rate of bone loss (Tang *et al.*, 2007)

Fig.1 Age wise distribution of the patients

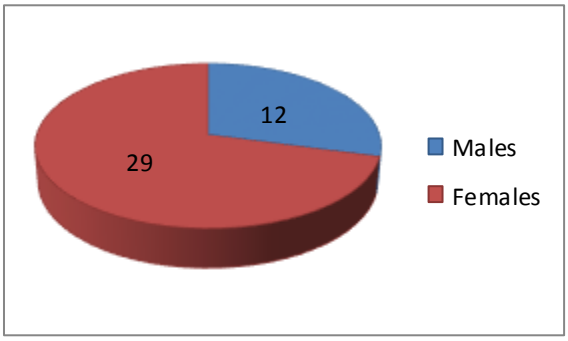

Fig.2 Types of fractures

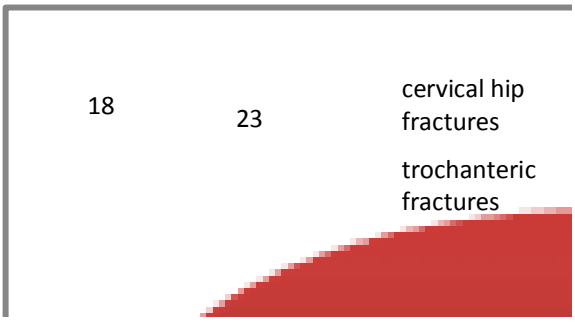

Table.1 Demographic details of the patients

Variables	Males	Females
Age (Years)	79.6 ± 8.1	75.7 ± 5.9
BMI (kg/m^2)	27 ± 3.9	29 ± 4.6
Underweight (acc to BMI)	2 (16.7%)	5 (17.2%)
Normal (acc to BMI)	4 (33.3%)	4 (13.8%)
Overweight (acc to BMI)	5 (41.7%)	11 (37.9%)
Obese (acc to BMI)	1 (8.3%)	9 (31.0%)

Table.2 Biochemical parameters of the patients

Biochemical parameters	Males	Females	Total
Ca (mmol/l) Before supplements After supplements	 2.1 ± 0.9 2.4 ± 1.2*	 1.9 ± 0.3 2.2 ± 0.9*	 2.0 ± 0.5 2.3 ± 1.3*
Vit D(nmol/l) Before supplements After supplements	 68 ± 23 323 ± 41*	 71 ± 21 329± 45*	 68 ± 22 326 ±44*
No of Vit D deficient patients (<75nmol/l)	11 (91.7%)	27 (93.1%)	38 (92.7%)

*: $p<0.05$

It has been observed that there is a reduction in the incidence of fractures on treatment with calcium alone, but treatment with vitamin D supplementation, there is a further reduction of 37% (Shea *et al.,* 2002; Papadimitropoulos *et al.,* 2002).

In the present study, the number of females with hip fractures was more than the number of males. The mean age of the patients in the study was 79.6 ± 8.1 in males and 75.7 ± 5.9 in females. The calcium levels in the males before supplements were 2.1 ± 0.9 mmol/l and in females it was 1.9 ± 0.3 mmol/l. These levels increased to 2.4 ± 1.2 mmol/l and 2.2 ± 0.9 mmol/l respectively after 3 months of treatment with the supplements in males and females respectively.

Similarly, the vitamin D levels were 68 ± 23 nmol/l in males and71 ± 21 nmol/l in females at base line which increase to 323 ± 41nmol/l and 329± 45nmol/l in males and females respectively after 3 months of treatment with the supplements. In the retrospective study by Gallacher *et al.,* (2005) the mean age was 80.5 years, 94% were aged over 60 and 74% patients aged over 75. The mean vitamin D level was 24.7 nmol/L (9.9 ng/ml), with 97.8% patients having vitamin D levels below 70 nmol/L and 91.6% having vitamin D levels below 50 nmol/L. As with our study, there were no significant differences by patient age or presentation of fracture. In yet another study, vitamin D insufficiency (plasma 25OHD < 50 nmol/l) was observed in 81% of the patients and the average plasma 25OHD was 41 nmol/l (Moosgaard *et al.,* 2005).

The number of cervical hip fractures was more in the patients especially in females compared to the intertrochanteric fractures. Similar case was reported by another study by Peng-Fei Li, where patients with femoral neck fractures were more common compared to the intertrochanteric fractures (Peng-Fei Li *et al.,* 2016). Since the hip fracture is a complex feature which involves many factors, a proper strategy to secure adequate and standardized perioperative treatment is important (Ayus *et al.,* 2012; Khalili *et al.,* 2012; Chen *et al.,* 2014; Uzoigwe *et al.,* 2014).

However, Calderazzi *et al.,* (2014) found that osteoarthritis strongly affects the location of the fracture in the proximal femur. Larrosa *et al.,* (2012) compared 128 patients with femoral neck fractures and 196 patients with femoral intertrochanteric fractures, and found the neck fractures to be more common.

With the treatment of the patients with the calcium and the vitamin D3 supplements, an improvement in the levels of the calcium and vitamin D3 levels have been observed which are estimated to reduce the bone loss of the

patient. Only calcium treatment is said to have a very small positive effect on the bone density (Shea *et al.,* 2007). It is also said to have a very small role to play in substantially reducing the fracture risk (Kanis *et al.,* 2005; Winzenberg *et al.,* 2006). Some studies have suggested no correlation between the calcium intake and the osteoporotic hip fracture (Tavani *et al.,* 1995; Michaelsson *et al.,* 2003).

The effect of vitamin D alone in fracture prevention is also unclear (Avenell *et al.,* 2005), though, one study reports no association with fracture risk (Michaelsson *et al.,* 2003). However, in the present study, a combination of calcium as well as Vitamin D3, has shown to have a positive effect on the bone density and reduction on the bone loss. Chapuy *et al.,* (1992) reported that calcium with vitamin D (1000 mg of calcium and 800 IU of vitamin D per day) significantly reduced the risk of hip and nonvertebral fractures among elderly women who were believed to be vitamin D– deficient.

In a multi centric study by Dukas *et al.,* (2004) in patients who were treated with only Vit D3, had more number of falls as compared to those who were treated with calcium also. It is estimated that vitamin D has a positive effect on the bone regeneration through its endocrine activity on the calcium homeostasis, thereby increasing the supply of Ca for fracture regeneration (Carmeliet *et al.,* 2015).

Calcium and Vitamin D deficiency are common findings seen in elderly patients with hip fractures. With proper treatment, the levels of both these substances rise to the normal levels thereby decreasing the incidence of fractures. Thus, Calcium and vitamin D represents a correctable risk factor for fragility fracture in the elderly, possibly specifically for the hip.

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