THE IMPORTANCE OF PROPER SUPPLEMENTATION WITH CALCIUM AND VITAMIN D IN THE PREVENTION OF FRACTURES

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ABSTRACT

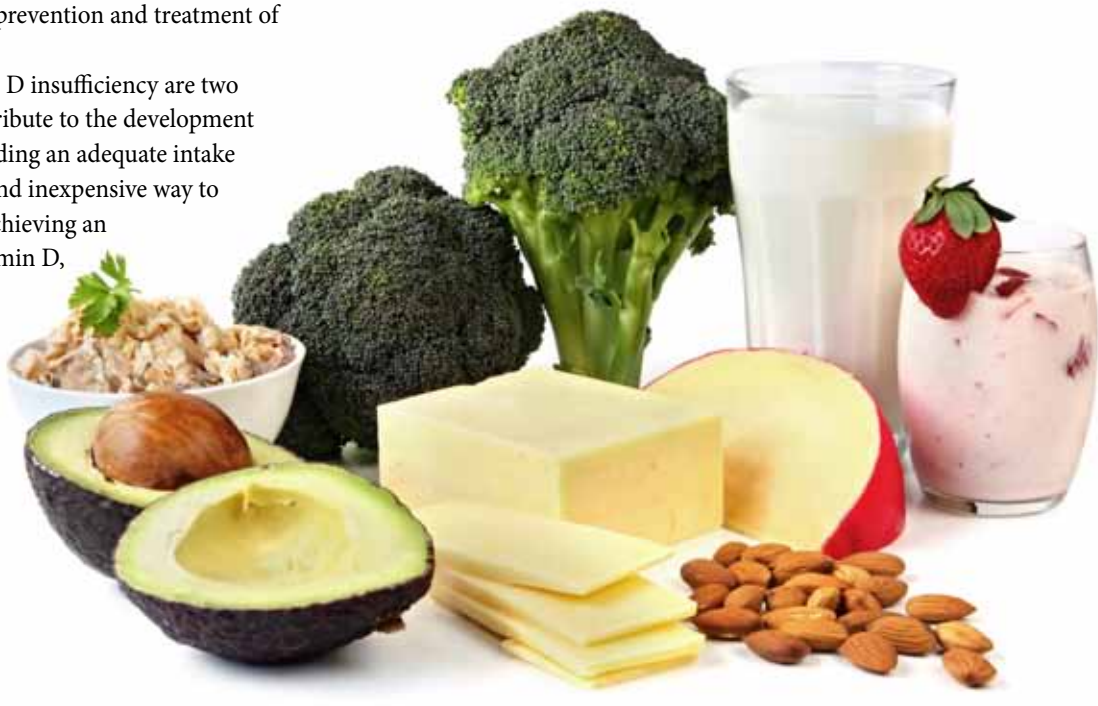
Osteoporosis is the commonest bone disorder affecting humans and it can lead to fractures in critical areas such as the proximal femur. These fractures can have a significant impact on the morbidity and mortality of the patient. Calcium and vitamin D have an important role in the prevention and treatment of osteoporosis. Identifying and correcting a low calcium intake and vitamin D insufficiency is an essential step in the management of osteoporosis. Failure to do so can seriously compromise fracture risk reduction.

Osteoporosis is a silent disease until it is complicated by fractures which often occur with minimal trauma[1]. These fractures affect critical areas such as the vertebrae and proximal femur so they can pose a serious threat to the health of the patient, as well as a significant financial burden to the health sector. Osteoporosis is the commonest bone disorder in humans and it is characterized by low bone mass, deterioration of bone tissue and disruption of bone architecture. Calcium and vitamin D play a crucial role in the prevention and treatment of osteoporosis.

Low calcium intake and vitamin D insufficiency are two important lifestyle factors that contribute to the development of osteoporosis and fractures. Providing an adequate intake of calcium and vitamin D is a safe and inexpensive way to help reduce fracture risk[1]. In fact, achieving an adequate intake of calcium and vitamin D, together with life-long participation in weight-bearing exercise, tobacco cessation, identification and treatment of alcoholism and other risk factors for fractures, such as impaired vision, are considered universal recommendations that should be given to the general population.

ROLE OF CALCIUM

Lifelong adequate calcium intake is vital to reach the peak bone mass and thereafter maintain bone health[1]. In order to maintain adequate calcium levels there has to be a balance of intake, absorption and excretion. Key operators in achieving this balance are the parathyroid glands which upon detecting low levels of ionized calcium, secrete parathyroid hormone (PTH). PTH works by increasing intestinal and tubular reabsorption of calcium, as well as promoting renal production of calcitriol ($[1,25\text{-}(OH)_2D]$) and bone resorption. 99% of the calcium body stores are situated within the skeleton where it provides mechanical strength. Bone acts as a mineral reservoir so when the exogenous supply is insufficient bone tissue will inevitably be resorbed from the skeleton to maintain serum calcium at a constant level. Obligatory losses of calcium that occur in urine, digestive tract, skin and nails need to be accounted for.



A balanced diet consisting of low-fat dairy products, vegetables and fruit can provide sufficient calcium and a number of other essential nutrients required for our health. The average dietary calcium intake is 600-700mg per day in adults aged over 50. This should be increased as a first line approach with the addition of calcium supplements when dietary calcium intake does not suffice. The US National Osteoporosis Foundation (NOF) and US Institute of Medicine (IOM) recommend a daily calcium intake of 1000mg/day in men aged 50-70 years, whilst in men aged 71 years or older and in women aged 51 years or older a daily intake of 1200mg/day is recommended[2]. Higher levels of intake have not been proven to confer an additional benefit but may on the other hand increase the risk of kidney stones, stroke and cardiovascular disease.

ROLE OF VITAMIN D

Vitamin D is essential for calcium absorption and to maintain bone health. The active metabolite 1,25-dihydroxyvitamin D regulates calcium absorption in the bowel, mediates mineralization of osteoid tissue within bone and has an important role in muscle function[3]. Thus vitamin D status is crucial in maintaining the integrity of the system which regulates calcium balance. The main source of vitamin D is cutaneous production after ultraviolet radiation. Regular exposure of hands, arms and face without the use of sunblock for 10 minutes between April-October two or three times a week will produce sufficient vitamin D to supply the annual nutritional requirements[4]. Dietary sources such as vitamin-D fortified milk, cereals, saltwater fish and liver can compensate for lack of sunlight exposure.

Vitamin D deficiency can be classified as mild (serum 25(OH) D 25-50nmol/L), moderate (serum 25(OH)D 12.5- 25nmol/L) and severe (serum 25(OH)D < 12.5nmol/L)[5]. The NOF recommends a daily intake of 800-1000 international units (IU) vitamin D in adults aged 50 and over. On the other hand, the IOM recommends an intake of 600IU until the age of 70 which increases to 800IU per day for those aged over 70[1]. There is a high prevalence of vitamin D deficiency in osteoporosis, especially those with hip fractures[6]. Identifying and correcting vitamin D deficiency is important in the management of patients with osteoporosis who are at risk, and it is also part of the universal recommendations. Individuals who are at risk include patients suffering from gastro-intestinal disorders, chronic kidney disease and chronic illnesses. Lack of sun exposure, obesity and dark skin are other common risk factors for vitamin D deficiency. In these patients serum 25(OH) D levels should be checked at baseline and sufficient replacement and maintenance therapy should be administered with the aim to achieve a target vitamin D level of approximately 75nmol/L. A significant proportion of patients will need more than 800-1000IU per day to correct the deficiency. The safe upper limit for vitamin D intake in the general population was increased to 4000IU per day in 2010[2].

Vitamin D deficiency can be treated with 50,000IU D_2 or D_3 per week or a daily dose of 6000IU for the duration of 8-12 weeks followed by a daily dose of 1500-2000IU. These doses may be higher in patients who are obese, on drugs that alter metabolism of vitamin D or suffer from malabsorption. Vitamin D supplementation is equally important to calcium supplementation in patients with osteoporosis and failure to do so can impede improvement of bone mineral density.

There is strong evidence to suggest that combined calcium and vitamin D supplementation can provide significant reduction in the risk of hip and non-vertebral fractures. They should always be prescribed in adequate doses in patients receiving osteoporosis treatment to achieve an optimal increase in bone mineral density and a reduction of fracture risk, together with regular weight-bearing exercise and smoking cessation.

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