Osteoporosis - An Emerging Disease of the 21st Century, Part 1: An Overview

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Abstract

Osteoporosis is a condition where bones are fragile with a poor bone mineral density. This increases the risk of fracture especially of the hip, vertebrae, and wrist. These fractures are usually termed "fragility fractures." In this article, we aim to provide a broad overview of osteoporosis—investigation, management, and prevention.

Keywords: Bone mineral density, dual-energy X-ray absorptiometry scan, fragility fractures, osteoporosis

Introduction

Osteoporosis means "porous bones" and results from a decrease in bone density leading to poor quality of bones. This occurs when there is a mismatch between the bone formation and bone resorption. The bones become fragile and are susceptible to fracture very easily.[1] It is important to diagnose the condition early and to take preventative measures so as to prevent fractures.

Epidemiology

Osteoporosis is estimated to affect about 20 million women worldwide. An osteoporotic fracture is estimated to occur every 3 s.[2] One in three women and one in five men will sustain an osteoporotic fracture.[2] About 80% of people who were in the high risk category and had sustained at least one fracture were never diagnosed or treated for osteoporosis. As estimated, about 50% of hip fracture would be occurring in Asia by 2050. The problem accentuates and mainly lies in the diagnosis and treatment of this condition especially in India where a majority of the population lives in rural areas with limited resources. About 26 million were estimated to suffer from osteoporosis in India in 2003, which is projected to rise to 36 million by 2013.[3] A major cause of osteoporosis and osteopenia in Indian women was noted to be due to inadequate nutrition.[4]

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Pathophysiology

Bone undergoes remodeling constantly replacing the old bone content with new content. About 10% of the bones are undergoing remodeling at a given point of time. Osteoclasts resorb the bone. This is followed by the synthesis and mineralization of new bone matrix by the osteoblasts in the cavity created. The amount of bone resorption and new bone formation is closely balanced with complex control mechanisms. Bone remodeling is dependent on (1) mechanical stresses, (2) systemic biochemicals like parathyroid hormone, calcitonin, vitamin D metabolites, growth hormones and estrogen, and (3) locally produced cytokines, prostaglandins, and growth factors. Bone loss begins at around 35-40 years with an increase following menopause in women.[5] Some of the factors influencing bone loss are shown in Table 1.

Bone remodeling is essential to replace the bone after micro-damage which occurs following normal activity thus keeping the bone healthy and strong. An imbalance between the two processes leads to osteoporosis. Osteoporosis is dependent on the peak adult bone mass which is around the age of 30 years. If the peak bone mass (PBM) is low then the bones may become fragile quickly with the onset of osteoporosis.[5]

Table 1: Factors influencing bone loss

Heredity
Hormones
Nutrition
Activity

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Fracture Risk

The most common sites which are susceptible to fractures are vertebrae, hip and wrist. Fractures occurring at these places secondary to osteoporosis are termed "fragility fractures." Fragility hip fractures result in significant morbidity and mortality in the elderly population.[6] Even though hip fractures are currently a major concern in the West, soon they would be a growing problem in Asia.[4] By 2050, about 50% of all hip fractures are predicted to occur in Asian patients. A significant proportion of these fractures would be occurring in India with a growing segment of the aging population.

To tackle this global problem of public health relevance, various organizations are involved like the International Osteoporosis Foundation, National Osteoporosis Foundation, Bone and Joint decade (BJD), etc. The BJD was launched in 2000 to reduce the impact of musculoskeletal diseases across the world. The BJD is endorsed by the United Nations, the World Health Organization, the World Bank, and health officials in 63 countries. "Keep People Moving" is the vision of BJD which is now in the second decade: 2010–2020.[7] Bone health and Osteoporosis is one of the five priorities of the BJD [Table 2]. The BJD brings together various professional, scientific, and patient organizations to reduce the burden of musculoskeletal diseases.

Bone Mineral Density

Bone mineral density (BMD) is a measure of calcium and other minerals in the bone giving it strength.[1] A BMD test is a test to calculate the amount of minerals in a given section of the bone. There are various tests to calculate BMD as given below:

1. Dual energy X-ray absorptiometry (DEXA)
2. Peripheral dual-energy X-ray absorptiometry (P-DEXA)
3. Dual photon absorptiometry (DPA)
4. Quantitative computed tomography (QCT).
5. Quantitative ultrasound

Ultrasound is a cost-effective method used as a screening tool to identify osteoporosis but needs confirmation by a DEXA scan.

Diagnosis

DEXA remains a gold standard for the assessment of BMD and the diagnosis of osteoporosis.[1] World Health Organisation (WHO) and International Osteoporosis Foundation (IOF) have devised an assessment tool called FRAX tool for the assessment of fracture risk, categorizing patients into low, medium, and high risk.[8]

WHO classification of BMD values are shown in Table 3.

Treatment

There are several drugs for the treatment of osteoporosis that is essential to prevent fractures in the future. These can be broadly classified into those which (1) prevent bone resorption and (2) promote bone formation. The list of drugs is given in Table 4. In addition, calcium and vitamin D supplements are essential to ensure that drug therapy is effective.

Prevention

Although there are various factors which play an important role in the development of osteoporosis, lifestyle factors can influence bone development in youth and also the rate of bone loss in adulthood. During childhood and adolescence there should be an emphasis on providing adequate calcium intake avoiding malnutrition. Regular physical activity and an adequate supply of vitamin D are also essential. The PBM determines the risk of osteoporosis, the higher the PBM the lower the risk of osteoporosis. Regular exercise and adequate calcium and vitamin D intake keep the bones strong. Avoidance of alcohol and smoking also help prevent osteoporosis.It is vital for the general practitioners to have a low threshold for diagnosis of osteoporosis in the vulnerable group. Any new onset of back pain should raise the suspicion of a possible vertebral compression fracture needing appropriate management. The average cost of a DEXA scan is around Rs 2500–3000 and that of an ultrasound is around Rs 1000.[3] With a per capita income of about Rs 10,000, these investigations can be expensive for the patients. Nevertheless,

Table 2: Priorities of the bone and joint decade 2010–2020

Arthritis – inflammatory and osteoarthritis
Bone health and osteoporosis
Pediatric musculoskeletal diseases
Spinal disorders and low back pain
Trauma and Injury

Table 3: WHO classification of BMD values

Status	Hip BMD
Normal	T-score of -1 or above
Osteopenia	T-score lower than -1 and greater than -2.5
Osteoporosis	T-score of -2.5 or lower
Severe osteoporosis	T-score of -2.5 or lower, and presence of at least one fragility fracture

T score – is the number of standard deviation above or below the BMD values for a healthy young adult. Z score – is the number of standard deviations above or below the BMD values for a population of the same age and gender. WHO: World Health Organisation; BMD: Bone mineral density

Table 4: Pharmacological agents for treatment of osteoporosis

Prevent bone resorption
Estrogen
Selective estrogen receptor modulators, Bisphosphonates
Human monoclonal antibody to receptor activator of NFκB ligand (RANKL)
Promote bone formation
Parathyroid hormone (PTH1-84) and Teriparatide (PTH1-34)
Improve bone strength
Strontium ranelate reduces fracture risk by improving bone strength mainly through effects on bone material properties

prompt diagnosis of the condition and adequate treatment could prevent fracture and long-term morbidity and mortality that could help save additional costs in the long run.

Conclusion

Osteoporosis is a serious public health problem which can lead to significant morbidity and mortality. It is essential to diagnose and treat this condition to prevent fragility fractures that can cause severe disability and changes after the event. There is an urgent need to increase awareness among the public and professionals to identify the seriousness of this condition and adopt preventative measures.

In this article, we have tried to provide an overview of osteoporosis. In the next issue, we aim to discuss more about osteoporosis in detail.

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