

Osteoporosis

A. Definition

- Osteoporosis is defined as a universal, gradual reduction in bone mass to a point where the skeleton is compromised, resulting in fractures from minimal trauma.

B. Prevalence

- Osteoporosis is often considered the “silent disease” because its progression is insidious and most individuals are unaware of the disease until a bone fracture occurs. About 1.2 million osteoporosis related fractures are reported each year in the United States. One in every two women and one in every eight men will suffer an osteoporosis-related fracture at some time during their lives.

C. Vertebral Fractures

- About 40 percent of women will have at least one vertebral fracture by the time they are 80 years of age. Vertebral compression fractures are often the first osteoporosis-related fracture to occur. Vertebral fractures can be painless and go undetected until a noticeable loss of height results (>1 inch).

D. Hip Fractures

- The annual hip fractured incidence alone is estimated to range from 147000 to 250,000, with approximately 80 percent resulting from minor trauma. Both hip and vertebral fractures can also cause psychological symptoms including depression, anxiety, fear, an anger.

E. Normal Bone Growth, Development, and Maintenance

- Skeletal weakness, which develops in osteoporosis, results in part from structural and quantitative abnormal connections or alterations in bone quality. These include changes in bone turnover and in rate of repair, as well as loss of connectivity of the trabecular elements that comprise cancellous bone.
- Bone is a living tissue in a constant state of turnover and renewal. Bone remodeling maintains healthy bone with an ability to store calcium essential for bone density, bone strength, and other vital body functions.
- With the decline in estrogen levels, osteoclastic and osteoblastic activity increase, but excess osteoclastic resorption occurs, causing a net bone loss of up to 2 to 3 percent per year for approximately 5 years.

F. Aging Changes

- Maximal BMD of cortical bone occurs in men and women in the second to fourth decade of their life, followed by a slow decline. Women have less bone mass at skeletal maturity, requiring less bone to be lost before the threshold for fractures is reached. At the time of menopause, the rate of bone loss accelerates sharply for approximately 5 years and then occurs more slowly until about age 70.

G. Bone Mass

- Low bone mass, as measured by BMD testing, is the single best predictor of increased fracture risk.

H. Medications

- Several medications contribute to a woman's risk of developing osteoporosis. Corticosteroids are the most common drug class implicated in causing osteoporosis. High-dose and chronic heparin administration can cause increased bone resorption and decreased formation. Chronic anticonvulsant therapy with phenytoin or a barbiturate (bone loss may begin as early as 6 months into therapy), especially with combined use of these agents, can result in decreased intestinal calcium absorption, hypocalcemia, and decreased serum vitamin D.

I. Clinical Presentation

- The common clinical presentation of a woman with osteoporosis is shortened stature (>1 inch) kyphosis and cervical lordosis (frequently referred to as dowager's or widow's hump), or a fracture most commonly of the vertebra, hip, or forearm.

J. History

- Osteoporosis results from failure to reach appropriate peak bone mass, significant and rapid postmenopausal loss of bone mass, ongoing age-related bone loss, and secondary risk factors.

K. Physical Examination

- The physical examination is performed to identify and evaluate clinical signs and symptoms of osteoporosis. Height should be measured accurately. The spine should be examined for symmetry, kyphosis, and cervical lordosis.

L. Diagnostic Procedures

- BMD is the strongest known predictor of fracture risk. Fracture risk increases as BMD decreases. BMD measures the amount of calcium present in the region of bone being evaluated.

M. Technology for Measurement of BMD

- Dual x-ray absorptiometry (DEXA) is the most widely used technology for obtaining bone mass measurement.
- At this time, DEXA measurement at the proximal femur is thought to be the most useful for predicting fracture and measurement at the lumbar spine is most accurate for monitoring response to therapy.

N. Prevention

- Osteoporosis prevention is pertinent to the health of women accros their life span.

A. Nonpharmacologic Approaches

1. Caffeine

- Excessive caffeine reduces mineralization of the skeleton and increases renal excretion of calcium. Caffeine ingestion should be decreased to the equivalent of less than 2 to 5 cups of coffee per day.

2. Smoking Cessation

- Smoking cessation is important because smoking had been associated with lower bone mass and increased fracture rates.

3. Alcohol Ingestion

- An association between alcohol use and low bone density and fractures has been found in some studies.

4. Exercise

- Two types of exercise have been shown to significantly increase bone density in randomized clinical trials. These are weight-bearing exercise (walking, jogging, basketball, soccer, hiking) and resistive exercise.

5. Fall Prevention

- Prevention of falls is critical for decreasing a patient's risk of sustaining fractures.

B. Pharmacologic Prevention and Treatment Modalities

1. Calcium

- **Physiologic Effects:** Equilibrium exists between the body's calcium requirements and bone resorption. Dietary calcium should be increased with dairy products, calcium-fortified juices, green leafy vegetables.
- Synergy between calcium and other osteoporosis prevention and treatment modalities is the key to promoting bone health for women of all ages.

2. Vitamin D and its Metabolites

- Vitamin D supplementation may be needed for the elderly, patients lacking exposure to sunlight, or individuals with renal disease because a decrease in calcitriol synthesis can occur.

3. Hormone Replacement Therapy

- **Therapeutic Effects:** ERT or HRT is one of two first-line therapies for the prevention and treatment of osteoporosis. Recent data suggest that ERT be continued into late life for the maintenance of high bone density.

4. Bisphosphonates

1. **Bone Effects:** Bisphosphonates are analogues of pyrophosphate that absorb onto the surface of hydroxyapatite crystals, especially at sites of active bone remodeling. Bisphosphonates inhibit bone resorption by decreasing osteoclastic activity and reducing the rate at which bone remodeling occurs.

5. Selective Estrogen Receptor Modulators

- Raloxifene, the only SERM approved by the FDA for the prevention or treatment of osteoporosis, had a 1.5 to 2.9 times higher affinity for the estrogen receptor than estradiol.
 - **Bone Effects:** Selective estrogen receptor modulators (SERMs) are a structurally diverse group of compounds that interact with the estrogen receptor to elicit either an estrogen agonist or an estrogen antagonist response.
 - **Therapeutic Effects:** Raloxifene increased bone density by 3 to 3 percent compared to placebo and reduced low-density lipoprotein (LDL) and total cholesterol by 10 to 12 percent.

- **Side Effects and Contraindications:** The most common adverse effects reported were hot flashes and leg cramps

H. Calcitonin

- **Bone Effects:** Calcitonin, a polypeptide hormone that acts as an antiresorptive agent, has been widely used to reverse bone loss observed in Paget's disease of bone, malignant and hyperparathyroid hypercalcemia, and osteoporosis.

I. Phytoestrogens

- Phytoestrogens are naturally occurring plant sterols that exert effects similar to estrogen. One type of phytoestrogen is the isoflavones, which are found in soy beans, garbanzo beans, and other legumes. These phytoestrogens have a low binding affinity for estrogen receptor.