Osteoporosis

Overview

Osteoporosis is defined as compromised bone strength that increases risk of fracture (NIH Consensus Conference, 2000). Bone strength is characterized by bone mineral density (BMD) and other bone qualities such as micro-architecture influenced by bone remodeling, bone turnover, mineralization and other factors that are more difficult to quantify, such as "damage accumulation." Decreased BMD with advanced age leads to age-related osteoporosis.

Sixty-five percent of adult bone is mainly composed of minerals such as calcium and phosphorus; 25% is water and the remaining 10% is organic bone matrix made primarily of collagen that provides flexibility. Bone is constantly being remodeled in cycles of formation and resorption by bone cells. Remodeling is in balance without any net change in bone mass before age-related bone loss begins. The state of balance is lost with advanced age with more resorption than formation. The main bone cells involved in the remodeling cycle are osteoblasts (bone formation), osteoclasts (bone resorption), and osteocytes (old osteoblasts – which stimulate osteoblasts when they sense mechanical strain in a bone). Bone cell functions are influenced by age, levels of calcium, vitamin D, parathyroid hormone, hormones, such as, estrogen and androgens and medications, for example glucocorticoids.

Key Points

Approximately 9 million Americans suffer from osteoporosis. Another 48 million have low bone mass and are at risk of developing osteoporosis (The National Osteoporosis Foundation, 2011); More than 2 million fractures in the USA were attributable to osteoporosis in 2005. One out of two Caucasian women 50 years of age or older experiences a fracture in their lifetimes.

Incidence of fractures in women exceeds that of stroke, MI & breast cancer combined in their lifetime.

Fracture risk in men is higher than that of prostate cancer. Twenty one percent of men, 50 years of age or older, will experience a fracture.

Osteoporotic fractures are a common cause of immobility in the elderly. Vertebral fracture is the most common type and accounts for 27% of all osteoporotic fractures. Wrist and hip fractures account for 19% and 14% of these fractures (Cauley, 2013.) Vertebral fracture may often be silent but can also affect many aspects of quality of life including physical (pain, compressed abdomen, spinal deformity), functional (decreased mobility) and psychosocial (depression). If one survives a fracture, the risk of recurrent vertebral fracture is 5-12 times greater.

Fifty percent of older adults with hip fractures will never walk without assistance and 25% will require long-term care.
Pain and depression associated with immobility often lead to failure to thrive and death. From 2000 through 2009, an estimated $22 billion was spent for osteoporosis and related fractures compared to $7 billion spent on breast cancer in the United States (Blume & Curtis, 2011).

**Assessment**

Dual energy x-ray absorptiometry (DXA) assesses bone mineral density (BMD). BMD is the traditional way to diagnose osteoporosis. BMD provides the skeletal measure; however, there are non-skeletal factors that are not captured by the DXA scans. Non-skeletal risk factors include increasing age, female gender, race (Asian or Caucasian), early menopause, low body weight, family history of osteoporosis or fracture, low calcium intake, low vitamin D, alcohol, physical inactivity, high caffeine intake, drug/steroid use, and smoking.

In addition to the DXA scan, screening for osteoporosis in the older adults should include a detailed history focusing on the risk factors described above. A physical examination will help identify older adults who are at risk of falling. While falls may not be directly linked to osteoporosis, fall prevention helps in fracture prevention.

The World Health Organization (WHO) has developed the Fracture Risk Assessment tool. The FRAX® calculates individual risk of fracture with and without BMD. The FRAX® algorithms provide a 10-year probability of hip fracture and other major osteoporosis related fractures (clinical spine, forearm, hip or shoulder fracture).

**Diagnosis**

Osteoporosis-a T-score of <-2.5 for BMD is considered osteoporosis

Osteopenia-a T-score between -1 to -2.5 is considered low bone mass

**Intervention**

The main goal of osteoporosis treatment is to prevent fractures. There are two main types of interventions, pharmacological and behavioral.

The National Osteoporosis Foundation (2011) guidelines for pharmacologic intervention with a prescription medication in postmenopausal women and men ≥50 years of age are:

1. History of hip or vertebral fracture
2. Other prior fractures and T-score between -1.0 and -2.5 at the femoral neck, total hip, or spine, as measured by dual-energy X-ray absorptiometry (DEXA).
3. T-score ≤-2.5 (DEXA) at the femoral neck, total hip, or spine, after appropriate evaluation to exclude secondary causes.
4. T-score between -1.0 and -2.5 at the femoral neck, total hip, or spine and secondary causes associated with high risk of fracture, such as glucocorticoid use or total immobilization
5. T-score between -1 and -2.5 at the femoral neck, total hip, or spine, and a 10-year probability of hip fracture \( \geq 3 \) percent or a 10-year probability of any major osteoporosis-related fracture \( \geq 20 \) percent based upon the US-adapted WHO algorithm.

The decision for treatment should be based on individual patients. FRAX (fracture risk assessment tool) developed by WHO provides some indication based on the patient's age, past medical history and family history with or without a bone mineral density (BMD).

Available pharmacologic interventions are:

**Oral Bisphosphonates:**

- Alendronate 10 mg/day or 70 mg once weekly
- Risedronate 5 mg/day, 35 mg once weekly, or 150 mg once monthly
- Ibandronate 150 mg once-monthly or 3 mg intravenously every three months

**Intra-venous Bisphosphonates**

- Zoledronic acid 5 mg administered intravenously (IV) once yearly
- Ibandronate 3 mg IV every 3 months

Precautions should be taken for side effects of bisphosphonates, e.g., esophagitis for any oral bisphosphonates. Osteonecrosis of the jaw (ONJ; avascular necrosis of the jaw), especially in people with compromised oral hygiene should be discussed at the time of treatment inception. ONJ and atypical fractures (e.g., femur shaft fracture) are also a concern in patients with long term use (> 5 years).

**Selective estrogen receptor modulators:** Raloxifene is a tissue selective estrogen receptor modulator (SERM) that also reduces the risk of vertebral fractures, lowers risk of breast cancer while it does not stimulate endometrial hyperplasia or vaginal bleeding. But it increases the risk of venous thromboembolism and so is not considered a first line agent for older patients.

**Estrogen/progestin therapy:** Due to increased risk of breast cancer, stroke, venous thromboembolism, and coronary disease, estrogen/progestin is no longer a first-line approach for the treatment of osteoporosis in postmenopausal women.

**Parathyroid hormone:** Teriparatide (recombinant human PTH) 20 mcg given subcutaneously daily is not recommended for use for more than 2 years. Patients with a history of cancer or other bone disease with higher bone formation are not candidates for this treatment. Usually, this is given to patients who did not improve on BMD after being on bisphosphonate for at least 2 years or longer.

**Denosumab:** A humanized monoclonal antibody against RANKL that reduces bone resorption is the newest medication that is given 60 mg sub-cutaneously every six months (to be administered by a trained health care provider).
Calcium and vitamin D supplementation: 500-600mg of calcium + 400 units of vitamin D one tablet twice a day is recommended with any other pharmacological intervention. Normal levels of calcium and vitamin D need to be confirmed to continue supplementation with this dosage.

Testosterone therapy: Hypogonadism is a common cause of osteoporosis in men. While testosterone is not recommended for primary osteoporosis, it is used as needed in men with hypogonadism and secondary osteoporosis. Caution needs to be practiced in patients with history of prostate cancer.

Behavioral interventions include:

Weight bearing exercise: Walking is recommended and suggested with or without pharmacologic intervention.

Smoking cessation: Cessation is recommended for all nicotine users.

Moderate level of alcohol: Less than 3 drinks per day are recommended for promoting bone health. Fall prevention: Improved balance and muscle strength are keys to preventing osteoporosis related fractures. Calcium and vitamin D supplementation are also recommended.

Prevention

Prevention of osteoporosis is multifactorial. Calcium and vitamin D supplementation and weight bearing exercise are recommended to prevent fracture and treat osteoporosis. The daily requirement of calcium for an older adult is about 1200-1500 mg. An eight ounce cup/glass of milk or fortified orange juice would provide about 300 mg of calcium. (Sweet et al., 2009; Holick, 2006; National Osteoporosis Foundation, 2011).

The American College of Sports Medicine (Chodzko-Zajko, Proctor, Singh, et al., 2009) recommends at least 2.5 hours of moderate intensity physical activity per week for healthy adults. Walking is a simple and easy way of weight bearing exercise that helps stimulate bone formation to improve balanced remodeling. Brisk walking at about 3.5 miles per hour (approx. 17 min/mi) is the equivalent of 4 METS. A MET is a measure of exercise intensity. MET levels ranging between three and five are considered moderate level physical activity. (Chodzko-Zajko, Proctor, Singh, et al. 2008)

Besides skeletal health, other environmental and behavioral factors, (e.g., fall prevention, smoking cessation) are also key factors for prevention of osteoporosis related fractures.
References


