The importance of bones in the human body through the viewpoint of osteoporosis p...

Health & Medicine

The bones are significantly important forms of connective tissues in the body that comprise primarily of fibrous protein collagen impregnated with a mineral phase of calcium phosphate (Braun & Anderson, 2007). This gives the bones the ability to withstand compression and bending forces. Bones consist of a thick outer cortex that surrounds a network of spongy trabecular bone. The trabecular framework and the cortex become thinner with age. The bones become more porous, fragile, and prone to fracture. Among other functions, bones collaborate with the skeletal muscles to facilitate movement and maintain the body posture. Bones undergo the remodeling process on a continuous basis (Meunier, 1998). During this process, the old and worn-out bones are broken down while new ones are re-built. The resorption and formation processes occur at almost equal rates, thus, maintaining the entire skeleton’s strength. The disorder associated with bone remodeling causes various health problems. One of the common diseases is osteoporosis. This disorder occurs when the body is unable to form enough new bones, absorbs too much old bone, or both (Meunier, 1998). The bones of an individual affected with osteoporosis become porous due to the bone tissue deterioration. Thus, the bones become fragile with increased risks of fracture (“ Medifocus guidebook on: Osteoporosis” 2011). The bone mass accrued during growth and the subsequent bone loss determine an individual’s probability of suffering from osteoporosis. Risk factors such as impaired balance, muscle weakness, cognitive impairment, and psychological medication facilitate the impacts of osteoporosis.

Pathophysiology

The pathophysiology of osteoporosis comprises the various genetic, hormonal, nutritional, and environmental factors, which determine the onset of both the primary and secondary osteoporosis. Genetics considerably influence the peak bone mass that is a major factor determining the risks of bone fragility in old age. Research reveals that genetics determine 50-85 percent of the variance in peak bone density, bone size, and hip geometry (Rizzoli, 2010). In addition, genetics contribute 40-60 percent of the variance in bone turnover and micro-architecture (Rizzoli, 2010). Various single-gene mutations, such as the collagen type 1 alpha and alpha 2, lead to bone fragility as they cause osteogenesis imperfect (Rizzoli, 2010). Moreover, inactivating mutations of the low-density lipoprotein gene causes pseudoglioma syndrome, while activating mutations cause a variety of syndromes associated with high bone mass and strength (Rizzoli, 2010). The multiple variations in DNA sequence determine the susceptibility of an individual to idiopathic osteoporosis and fractures. The peak bone mass also varies due to heritability, concerning the ethnic origin and body size. Evidence indicates that Caucasian men and women have a higher risk of hip fracture due to low mineral density compared to the African-American men and women (Meunier, 1998).

Hormones play a crucial role in the bone mass development, maintenance, and loss in both the growing and aged skeleton. Estrogen is vital for the closure of the growth plates in both the males and females (Rosen, 1996). Thus, girls with delayed menarchae exhibit lower bone mass density. Sex steroids are responsible for the greater bone mass and size in males.

Analysts have attributed the difference in the hormonal composition between the males and females as the cause of the high case of osteoporosis in women. However, the decline in the estrogen level and the testosterone level in women and men respectively, due to the old age, considerably contribute to the onset of osteoporosis (Rizzoli, 2010). The normal premenopausal levels of estradiol reduce cases of bone turnover and negative bone balance. Moreover, the parathyroid hormone enables the regulation of the bone turnover. The hormone increases bone turnover through the production of various local factors such as the IGF-1 (Rosen, 1996). It opposes cacitonin and activates osteoclasts. This facilitates the bone resorption. The growth hormone is also another significant stimulus that facilitates bone formation and resorption.

The calcium and phosphate minerals are significantly essential in the process of bone formation. The hormone calcitonin inhibits the activation of osteoclasts and promotes the deposition of calcium and phosphate into bone (Rosen, 1996). The lack of adequate supply of these minerals results in altered bone formation. With age, the body may reabsorb calcium and phosphate from the bones, weakening the bone tissue. This is likely to result in fractures. Other dietary factors that determine the peak bone mass include proteins, caffeine, and other minerals.

Several environmental factors considerably contribute in the etiology and progression of osteoporosis. These include smoking, alcoholism and various medications that are causative agents in the pathophysiology of osteoporosis. Tobacco is attributed to the reduction in bone density as it

alters the levels of serum estrogen (Rosen, 1996). Alcohol is toxic to osteoblasts and, thus, disrupts the normal bone remodeling cycle. High Glucocorticoids levels also interfere with the bone remodeling cycle and calcium regulation.

Clinical manifestation and diagnosis

Osteoporosis rarely manifests itself until fractures, spinal deformity, dorsal kyphosis, or cervical lordosis occurs (Hoffmann, 2008). The areas at most risk are the vertebrae of the lower spine, wrist, and the femur close to the hip joint where there is the presence of the honeycomb bone, which is considerably affected by shocks of a fall (Eckman, 2010). Vertebral-body compression may occur due to various fractures. Bending, uplifting, or other minimal stresses are the major causes of the fractures. This vertebral collapse manifests through the pain, experienced during standing or abrupt movements (Aeib et al., 2005). Spinal fractures cause height loss and the rounding of the back. Hip fractures cause adverse complications resulting in disability and increased mortality. Wrist fractures also cause deformity and alter the daily activities. Unexplained fractures call for the determination of bone quality and density. The pathological findings associated with osteoporosis include the loss of coarse cancellous bone and thinning cortex. The trabeculae in the cancellouas bone thins and becomes porous. This increases fracture risks. Medical professionals can establish these occurrences through tests such as DEXAS scanning (Braun & Anderson, 2007).