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Pharmacologic Management of Osteoporosis

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ABSTRACT

Osteoporosis is a serious health problem of endemic proportions in the United States. Approximately 50% of women will experience an osteoporosis-related fracture during their lifetimes. With the increase in the population of women age 65 and older, nurses need to be familiar with osteoporosis risks, prevention strategies, and screening guidelines to promote well-woman care. We provide an overview of the medications approved by the Food and Drug Administration (FDA) to treat and prevent osteoporosis.

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In 2011, the first members of the Baby Boomer generation in the United States reached age 65, and with each subsequent year 8,000 more individuals will also reach this milestone. In 2010 there were 40.4 million U.S. adults age 65 and older (13.1% of the population); 23 million were women (U.S. Department of Health and Human Services [USDHHS], 2011). The population of the United States is aging, and nurses need to be aware of common diseases associated with this process. Osteoporosis, which primarily affects older women, can be identified and successfully managed with lifestyle and pharmacologic interventions.

According to the World Health Organization (WHO, 2004), osteoporosis is defined as a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue that increase the risk for fracture. The WHO (2004) defines *osteoporosis* as a bone mineral density of –2.5 standard deviations (SD) or more below the average value of young healthy women. Osteoporosis can be further classified into two groups. Primary osteoporosis is related to the normal process of aging and the bone metabolism cycle; secondary osteoporosis occurs when bone metabolism is affected by outside processes, such as medications or a chronic underlying disease. Osteopenia is a related disorder. It is defined as low bone mineral density (density between normal levels and levels for osteoporosis) (Tufts, 2011).

Osteoporosis is a major health problem. Worldwide, osteoporosis is expected to affect approximately 200 million persons, and approximately one in three women older than age 50 will experience a fracture due to this disease (International Osteoporosis Foundation [IOF], n.d.). Approximately 10 million Americans older than age 50 are diagnosed with osteoporosis, and 34 million with osteopenia (USDHHS, 2004). In the United States it is estimated that one in two White women will experience a fracture of the wrist, hip, or spine compared to one in eight women who will develop breast cancer (Cummings & Melton, 2002; National Osteoporosis Foundation [NOF], 2013a; WHO, 2004). Medical care of individuals with osteoporosis is estimated to cost roughly $14 to $20 billion annually (Becker, Kilgore, & Morrisey, 2010).

In this article, we provide nurses with a basic understanding of osteoporosis and review the medications approved by the U.S. Food and Drug Administration (FDA) for the treatment and prevention of osteoporosis in postmenopausal women.

Overview of Bone Physiology

Bone formation and growth begins during fetal development and continues through adulthood. By age 30 peak bone mass will be achieved. After this point bone growth and development is the result of an ongoing cyclic process of bone formation and reabsorption called remodeling. The cells

responsible for the remodeling process are osteoblasts and osteoclasts. Derived from hematopoietic and stromal stem cells, osteoclasts are responsible for the reabsorption of bone, whereas osteoblasts are responsible for bone synthesis and mineralization (Raisz, 1999). Together both cells also assist with maintenance of the body's supply of calcium, magnesium, and phosphorus, which are needed to form healthy bones. Bones are also made of two layers: trabecular and cortical layers. Trabecular bone, found in the inner core, is extremely porous and has a greater surface area. It is highly vascular and is responsible for the production of red blood cells. Trabecular bone is primarily found in the long bones of the skeleton. Cortical bone forms the outer layer of the bone and is less porous. This layer is stiffer, denser, and stronger than trabecular bone (Riggs, 2000).

The normal aging process and estrogen loss related to menopause increase a woman's risk for osteoporosis. Estrogen plays a significant role in the regulation of osteoblast and osteoclast production. However, when estrogen deficiency occurs this regulatory process is disrupted, and the result is a decrease in the production of osteoblast and an increase in osteoclast production. The effect is an increase in bone reabsorption. The loss of estrogen may accelerate bone loss for approximately 5 to 8 years (Norman, 2013).

Not only does estrogen loss contribute to the risk of osteoporosis for postmenopausal women, estrogen deficiency early in life can be even more harmful. Amenorrhea due to estrogen deficiency in teens and young adults can have a long-term effect on bone mineral density. Conditions such as female athlete triad, polycystic ovary syndrome, anorexia, and bulimia can all increase a young woman's risks for osteopenia and osteoporosis (Gordon, 2010). Significant estrogen deficiency during adolescent development, when bone growth and development accelerates, can have long-term health consequences.

Risk Factors for Osteoporosis

Other than estrogen loss, multiple nonmodifiable and modifiable factors can place women at risk for osteoporosis. Nonmodifiable risks may include age, gender, race/ethnicity, family history of osteoporosis, and previous fracture. For example, advanced age, being a female, White, Asian, or Hispanic may increase risks (North American Menopause Society [NAMS], 2010). However, risks are also dependent on other more modifiable factors such as inadequate calcium intake, alcohol use/abuse, and smoking (Rizer, 2006) (see Table 1). Body mass index (BMI) related to being thin or underweight (BMI $\leq$ 21 kg/m$^{2)}$ has been also associated with an increased risk for fracture, especially with progressing age, whereas a greater BMI can be protective (NAMS, 2010).

Table 1: Risk Factors for Osteoporosis

Non-modifiable risk factors	Modifiable risk factors
Age	Alcohol/smoking
Female gender	Frequent falls
Family history	Low BMI
Previous fracture	Poor nutrition
Genetic or medical disorders	Excessive salt or vitamin A intake
Race/Ethnicity	Calcium & vitamin D deficiency
Menopause	Eating disorders
Long term glucocorticoid therapy	Estrogen deficiency
Rheumatoid arthritis	Sedentary lifestyle

Note. This list is representative, not comprehensive.

Women have a greater risk of osteoporosis fractures than breast cancer.

In addition medical conditions and medications may increase a woman's risk for osteoporosis. The medications associated with bone loss may include aluminum, anticoagulants, anticonvulsants, aromatase inhibitors, barbiturates, chemotherapeutic drugs, cyclosporine A and Tacrolimus, Depo-medroxyprogesterone, glucocorticoids, gonadotropin releasing hormone agonists, lithium, methotrexate, proton pump inhibitors, premenopausal use of Tamoxifen, and thiazolidinediones (USDHHS, 2004; NOF, 2013a). Diseases of the hypogonadal, endocrine, gastrointestinal, hematologic, autoimmune, rheumatologic, and central nervous systems may all play a role in osteoporosis risk. Examples of specific medical conditions that are associated with bone loss or have detrimental effects to the bone may include excess urinary calcium excretion, vitamin D deficiency, multiple myeloma, hyperparathyroidism and Cushing's syndrome, disorders of collagen structures, and renal failure (NAMS,