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Pathophysiology of Osteoporosis

Sarah Orr

Otterbein University, sarah.orr1115@gmail.com

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Osteoporosis

Sarah Orr, BSN RN

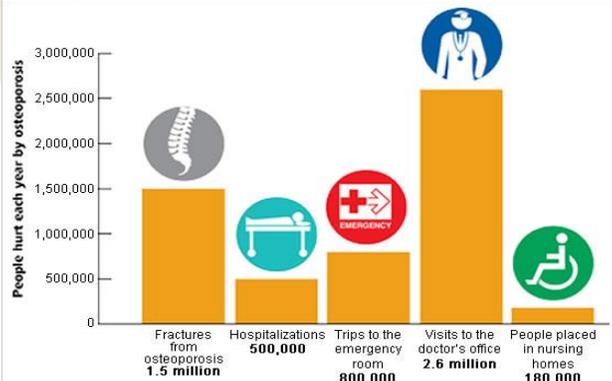
Otterbein University, Westerville, Ohio

Underlying Pathophysiology

- The pathophysiology of osteoporosis can be summarized as more bone lost than gained (Berry, 2019)
- When the osteoclasts reabsorb more bone than is being created, osteoporosis occurs (Tong et al, 2019)
- Understanding bone:
 - The bone is partially made up of osteoblasts, which make bone
 - The bone matrix is comprised of osteoids
 - Finally, the bone also contains osteoclasts which destroy or reabsorb bone (Tabatabaei-Malazy et al, 2017)
- The activity of bone cells is determined by the balance of cytokines- imbalances result in osteoporosis (McCance & Huether, 2018)
- Receptor activator of nuclear function ligand (RANKL): Produced by osteoblasts, essential for osteoclast development and efficacy (Tabatabaei-Malazy et al, 2017)
- Hormones play an essential role in the balance of bone integrity (French & Emanuele, 2019)
 - estrogen, parathyroid hormone, and testosterone are key to bone balance (French & Emanuele, 2019)
 - estrogen is thought to be the most essential hormone to bone stability: estrogen receptors exist on osteoblasts triggering bone genesis (French & Emanuele, 2019)
 - lack of estrogen results in increased bone reabsorption and compromised formation (Tabatabaei-Malazy et al, 2017)
 - Genetic coding of an individual may predispose them to osteoblasts and osteoclasts that function out of balance (French & Emanuele, 2019)
 - Certain pathologies can have a secondary impact on bone density resulting in osteoporosis (Hart, 2016)

Significance of Pathophysiology

- When estrogen levels are reduced in old age, specifically menopause for women osteoporosis becomes a significant issue- post menopausal women are at a significant risk for development of osteoporosis (French & Emanuele, 2019)
- Fragility fractures are significant complication associated with the progressive loss of bone integrity related to osteoporosis (French & Emanuele, 2019)
- Mortality rates increase as a result of fragility fractures. Hip fractures have an increased mortality of 5-8 times during the initial 3 months (Nuti et al, 2019)
- Increased mortality rates fluctuate, yet association with fragility fractures remains increased for 10 years (Nuti et al, 2019)
- Osteoporosis is not detectable until up to 30% of bone loss has already occurred (Nuti et al, 2019)
- A patient may not be screened for osteoporosis until after a fragility fracture has already occurred (Nuti et al, 2019)
- The cumulative morbidity and mortality associated with the fractures that result from osteoporosis have a profound impact on the healthcare system and on quality of life for patients (Nuti et al, 2019)



Signs, Symptoms and Clinical Manifestations

- There are often no early signs or symptoms of osteoporosis (McCance & Huether, 2018)
- The compromised bone determines the presentation of symptoms (McCance & Huether, 2018)
- Bone deformities may occur as disease progresses and integrity of the bone is compromised (McCance & Huether, 2018)
- Pain does not usually occur until a fragility fracture occurs (McCance & Huether, 2018)
- Kyphosis and loss of height are presentations that may occur as time compromises bone density (McCance & Huether, 2018)
- Fragility fractures occur as the bone weakens, they are most common to long bones (McCance & Huether, 2018)
- Certain low impact fractures of hips spine and wrists are possible indicators of pathological presence of osteoporosis due to the likely hood of compromised bone integrity (Jantzen et al, 2016)
- Colles' fracture in the wrist is considered an early pathologic sign of osteoporosis (Jantzen et al, 2016)

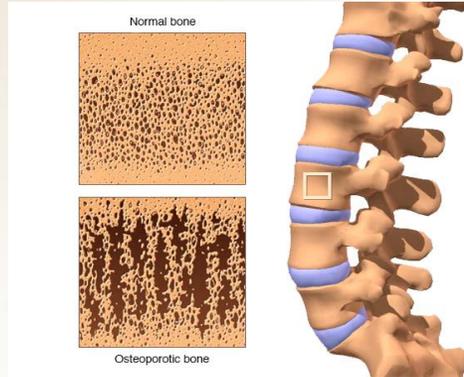
“Your bones are for life, look after them and they will carry you far.” ~Susan Hampshire

What is Osteoporosis?

- Osteoporosis is the progressive loss of bone density (Berry, 2019)
- Osteoporosis is the most common bone disease (McCance & Huether, 2018)
- Osteoporosis complications associated with fractures and increased morbidity and mortality
- Almost twice as common in women as in men (Tabatabaei-Malazy et al, 2017)
- Bone loss may not be detected until up to 30% of bone loss has already occurred (Berry, 2019)

Why is Osteoporosis awareness important?

- Every 3 seconds a woman suffers from an osteoporotic fracture (Tabatabaei-Malazy, Salari, Khashaya, & Larijan, 2017)
- This disease has increasing prevalence world wide- first, second and third world countries (Kalkim ,Daghan, Ercan & Ibc, 2018)
- Disability associated with osteoporosis is devastating and costly (Berry, 2019)
- Awareness and prevention are essential (Yeam et al, 2018)



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Case Study of Osteoporosis

Mary Sue Ellis is a 72 year old Caucasian female. She is seldom active. Her health history is benign except early menopause and hypothyroidism. Mary's doctor routinely encourages her to remain active and participate in weight bearing exercise.

Early one morning Mary Sue is getting dressed for the day. She slipped on some water on her bathroom floor.

Mary Sue was unable to get up. Her husband called the paramedics who brought her to a local hospital. Mary Sue argued her fall was minor and low impact

After operative stabilization, Mary Sue is assessed and treated with Physical and Occupational therapies. She was also started on denosumab.

Once discharged, Mary Sue went to inpatient rehab where she was able to participate in aggressive rehabilitation. Mary Sue was encouraged to continue weightbearing exercises once home to reduce disease progression and optimize bone density.

Testing and Diagnosis

- Distinguishing primary from secondary osteoporosis is essential (Nuti et al, 2019)
- History and full physical assessment are key components of diagnosis and differentiation between primary and secondary osteoporosis (Nuti et al, 2019)
- X-ray densitometry (DXA) is utilized to determine Bone Mineral Density (BMD) which classifies the degree of degeneration (Nuti et al, 2019)
- Computed Tomography (CT) scans may also be utilized to assess bone density (McCance & Huether, 2018)
- The World Health Organization has established a calculation that generates a T-Score. This is used to diagnose severity of degradation (McCance & Huether, 2018)

Class	T Score
Normal	+1 to -1
Osteopenia	-1 to -2.4
Osteoporosis	-2.5 or less

(Nuti et al, 2019)

Medical Management

- The most effective method to manage osteoporosis is prevention and lifestyle optimization
 - Weight bearing exercise, at least 30 minutes a day
 - Adequate Calcium and Vitamin D intake
 - Healthy diet
 - Smoking cessation
 - Moderate alcohol consumption, two or less a day
 - Limiting caffeine consumption
 - Medications:**
 - Bisphosphonates: First line of treatment, reduce osteoclast activity and increase their destruction
 - Denosumab: reduces osteoclast activity and increases their destruction: Reduces the binding of RANKL- good alternative for those in renal failure
 - Other medications: Estrogen replacement, selective estrogen receptor modulators, calcitonin, and more
 - Supplements: B12, Vitamin K, folic acid ect
- Source: (Tabatabaei-Malazy et al, 2017)

Implications of Nursing Care

- Teaching early preventative measure is essential for the management of osteoporosis (French & Emanuele, 2019)
- All advance practice nurses should strive to educate what their patients, specifically women, can do throughout their lifetimes to reduce the impact of osteoporosis (French & Emanuele, 2019)
- When caring for a patient who has suffered a fragility fracture from osteoporosis, the advance practice nurse must consider how the fracture will impact the quality of life of the patient (French & Emanuele, 2019)
- Fragility fractures will cause 40% of women to lose the ability to walk, twice that will lose the ability to perform one task of living (French & Emanuele, 2019)
- Advance practice nurses must be aware of which factors put a patient at increased risk for osteoporosis. Patients at risk must be screened regularly for the presence of disease (French & Emanuele, 2019).

Conclusion

Osteoporosis is a progressive degenerative disease where the bones of the body become more porous and prone to fracture. The disease is primarily asymptomatic until a complication occurs. The fragility fractures that are the hallmark of osteoporosis have significant associated morbidity and mortality (Nuti et al, 2019).

The best and most effective method for managing osteoporosis is through prevention. For this reason it is essential that each advance practice nurse be aware of preventative steps as well as which patients are the most at risk for the disease (Nuti et al, 2019).

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