Musculoskeletal System
Metabolic Bone Disorders:
Osteoporosis, Osteomalacia, Paget's Disease

Osteoporosis

- Chronic, progressive metabolic bone disease characterized by
  - Porous bone
  - Low bone mass
  - Structural deterioration of bone tissue

All of this = bone fragility ➔ risk for fractures

- More common in women than men for several reasons:
  - Lower calcium intake
  - Smaller frame ➔ less bone mass
  - Bone reabsorption begins earlier and accelerates after menopause
  - Pregnancy and breastfeeding ↓ woman's skeletal reserve of calcium; unless intake is adequate
  - Longevity increases likelihood

- **Primary Osteoporosis:**
  - Idiopathic- unknown
  - Hormonal imbalance, faulty metabolism, or poor calcium intake
- **Secondary Osteoporosis:**
  - Caused by diseases & meds
  - Malnutrition, alcohol, rheumatoid arthritis, lactose intolerance, hyperthyroidism , hypogonadism
- **Risk Factors:**

– Uncontrollable Risk Factors

- Female gender – white or Asian ethnicity

– Small frame

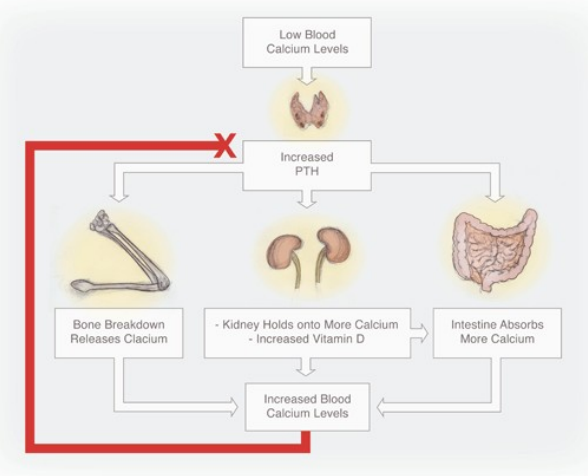
– African American females have > bone mass than white females
  - Less fat and estrogen produced in smaller women

- Fair complexion – vitamin D status
- Family history of OP
- ↑ Age
  - Oophorectomy or early menopause < 45 yrs
  - Immobile for a long period of time
  - Certain diseases – anything that affects intestinal absorption or urinary elimination of Ca^+
  - Long-term use of corticosteroids
  - Low testosterone level in men

– Controllable Risk Factors:

- Excess alcohol intake - ↑ ca+ excretion and ↓ ca+ absorption
- Cigarette Smoking - ↓ bone mass, early menopause, ↓ estrogen, ↓ ca+ absorption
- Caffeine - ↑ ca+ excretion
  - Carbonated drinks – phosphoric acid
- Sedentary lifestyle- exercise 3x/week
- Insufficient Ca^+ intake
- **Pathophysiology**
  - Bone is dynamic, constantly formed & reabsorbed
  - Bone reabsorption exceeds bone deposition
  - Minerals stored in cortical (compact) bone or trabecular bones; more loss of trabecular bone than compact
  - Youth - Ca^+ is deposited quicker than loss

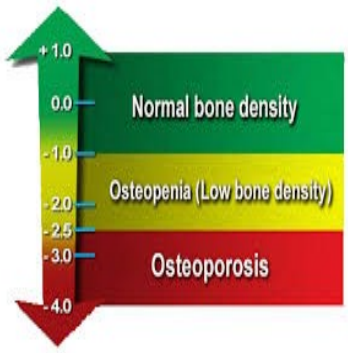
- Bone formation > reabsorption
- Bone growth = 10-20 yrs old
- Bone strength = 20-30 yrs old
- Peak bone mass = 30-35 yrs old
- After age 36 yrs, reabsorption > formation
- ↑ loss due to ↓ estrogen levels at menopause or post- oophorectomy
- Blood level of Ca^+ regulated by parathyroid hormone
- ↓ serum Ca^+ stimulates the synthesis & release of PTH
- Most commonly in**: spine, hips, & wrist**
- Interference with bone metabolism: medications (warfarin, cyclosporines, glucocorticoids)



- **Clinical Manifestations:**
  - "silent disease" because there are no symptoms
  - Later symptoms include:
    - Sudden strain
    - *Fractures – may be 1st symptom*
    - Pathological fractures = fracture easily under stress that would not normally break
    - **Vertebral fx most common site**; **hx of fx = risk factor for subsequent fxs**
      - Back pain
      - Loss of height – gradual
      - Spinal deformities – kyphosis
      - Protruding abdomen & breathing issues

- **Diagnostic Studies:**
  - H & P
  - Serum Ca^+, phosphorus, alkaline phosphatase (elevated after fx), 24° urine for Ca
  - <u>Bone Mineral Density</u>
    - Looks at peak bone mass and amount of bone loss; can be measured by either US or DXA
    - Quantitative US- sound waves to heel, patella, or tibia
    - Dual energy x-ray absorptiometry (DXA)
      - Trabecular & cortical bones: hip, forearm, & lumbar
      - Used to calculate total body Ca^+ concentration

- T score – bone mineral density measurements compared with young adult reference population (-2.5 or less = osteoporosis)
- Bone Mass (Value for BMD):
- Normal: within 1 SD (+1 or −1) of mean.
- Low bone mass (osteopenia): between 1 and 2.5 SD below (−1 to −2.5 SD).
- OP: 2.5 SD or more below (−2.5 SD or lower).
- Severe: more than 2.5 SD below and there have been one or more osteoporotic fractures



- X-rays only show bone loss of 30% or more

- **Collaborative Care:**
  - Focus on proper nutrition, Ca^+ supplements, exercise, prevention of fractures, & drugs
  - Prevention & treatment depend on adequate Ca^+ intake 1000-1500 mg/day plus Vit. D (800 u – 1000 u)
  - Exercise
  - Quit smoking & ↓ ETOH intake

- **Nutritional Therapy:**
  - Pre-menopausal women need 1000mg/day of Ca^+ (men 19-70yrs)
  - Post-menopausal women need 1200mg/day (men >71yrs)
  - Can take too much Ca^+ = kidney stones
  - Need to slow bone loss in pts with OP

– Dairy foods have the highest amount of Ca^+

– Good sources: milk & milk products, green leafy vegetables, seafood, orange juice, almonds

- Poor sources: eggs, poultry

– Supplemental Vitamin D

• Necessary for Ca^+ absorption

• Need 800 IU

– Ca^+ supplements:

• Check total # of elemental Ca^+, not mg (1 TUM = 500 mg of Ca carbonate = 200 mg of elemental Ca)

• Ca^+ supplements ➔ constipation & bloating

• Take with a full glass of water to prevent kidney stones

- **Drug Therapy:**
- **Estrogen** replacement after menopause
- Estrogen decreases osteoclasts (destruct bones)
- Not used for postmenopausal osteoporosis due to increased risk for breast cancer, CVA, DVT, & possibly heart disease (short-term)

– **Calcitonin** (Fortical, Calcimar)
- ↓ pain with fracture
- Blocks the effects of PTH on bone reabsorption, inhibits osteoclast activity
- ↓ bone loss
- IM, SC, intranasal
- Will need calcium supplementation to prevent secondary hyperparathyroidism

– **Bisphosphonates** (etidronate/didronel, alendronate/fosamax, risedronate/actonel, ibandronate/boniva, zoledronic acid/reclast)
  – prevention and tx of OP
- Inhibit osteoclast activity – mediated bone reabsorption
- Intracellular uptake of med
- Interacts with food → empty stomach; remain sitting
- Take 1st thing in AM with full glass of water
- ulcers & GI side effects
- s/fx – anorexia, wt loss, gastritis; need dental check ups

Zoledronic Acid (Reclast)
-IV bisphosphonate - given once a year or every 2 to prevent OP
-RFP & Serum Ca^{+} prior to admin

– **Selective Estrogen Receptor Modulators** (raloxifene /Evista)
- Binds to estrogen receptor & stimulates estrogen
- Does not ↑ breast CA risk
- S/fx– blood clots, leg cramps, hot flashes

– **Parathyroid Hormone** (teriparatide/Forteo)
- Stops bone loss & helps bone growth (stimulates osteoblasts)
- Injectable (SC) - daily
- S/fx: leg cramps, dizziness

- **Treatment of Vertebral Compression Fractures**

– Bedrest
– Position of comfort
– Muscle relaxants
– Local heat
– Move as a unit - logroll
– OOB ASAP
– Teaching – no forceful movements

- **Safety Measures**

– Prevent injuries & falls
– Proper fitting shoes with non-skid soles
– Regular vision checks

- Caution with meds
- Handrails
- Good posture
- Keep walkways free of clutter
- No loose rugs
- Good lighting

- **Safety Measures**
  - **<u>Avoid:</u>**
  - Harmful lifting & bending
  - Lifting heavy objects
  - Straining back
  - Bending at the waist
  - Twisting body from side to side
  - Standing on chairs

- **Nursing Diagnosis:**
  - Acute Pain
  - Deficient Knowledge
  - Risk for Injury/Falls
  - Impaired Physical Mobility

<u>Osteomalacia</u>

- **Definition**
- Inadequate mineralization of bone – Vitamin D deficiency
- Softening & deformity of bones 2° to insufficient minerals
- Bones become abnormally soft
- For adults, it's the same as Rickets in children
- ↓ Vitamin D, so ↓ absorption of Ca^+
- ↓ Vitamin D interferes with normal mineralization of bones, leads to ↓ calcification = soft, deformed

- **Etiology:**
  - Poor absorption
  - Lack of sunlight exposure (sunscreen= risk factor; long-term nursing home residents; darker skin)
  - Chronic diarrhea – Crohn's or ulcerative colitis
  - Pregnancy
  - Kidney disease
  - Inadequate intake
  - Drug therapy (phenytoin/dilantin, fluoride, barbiturates)

- **S/Sx:**
  - Persistent skeletal pain, difficulty rising or walking
  - Progressive weakening, weight loss, progressive deformities, extremity deformities
  - Fractures with delayed healing

- **Dx:**
  - Labs = ↓ Ca^+ & phosphorus, ↑ alkaline phosphatase
  - X-ray = bone demineralization & deformity

- Looser's Transformation Zones → ribbons of decalcification in bone – diagnosis OM (pseudo fractures)

- **Treatment:**
– Supplements of Vitamin D, Ca^{+}, & phosphorus
– ↑ Vitamin D via sunlight & dietary intake

- **Nursing Diagnoses:**
– Impaired Physical Mobility
– Risk for Injury
– Acute Pain
– Imbalanced Nutrition: Less than Body Requirements
– Disturbed Body Image

<u>Paget's Disease</u> (osteitis deformans)

- Chronic bone disease
- Seen more in men
- **Etiology:**
  - Unknown (viral)
  - Often have a family history
  - Possible slow viral infection, biochemical collagen defect, or benign neoplastic condition
- **Pathophysiology**
  - Excessive bone reabsorption followed by **excessive & abnormal bone replacement**
  - Softening, enlargement, & severe deformity
  - ↑ vascularity with bones – new bone is weak and brittle, prone to fractures
  - Common sites = spine, femur, skull, pelvis, & tibia

– Stages:
- Active: ↑ osteoclastic activity – excessive bone reabsorption
- Mixed: Compensatory ↑ bone formation – osteoblastic activity
– Thick bones, irregular pattern, ↑ vascularity
- **S/Sx:**
  - May be asymptomatic – earlier stages
  - Skeletal pain – mild to severe
  - Fatigue – early
  - Bowleg – early
  - Waddling gait – early

- **Dx:**
  - ↑ alkaline phosphatase (advanced disease)
  - X-ray = affected bone is curved & the bone cortex is thickened
  - Bone scans – show increased uptake in certain areas

- **Complications:**
  - Pathologic fractures – most common, sometimes 1st sign
  - Osteosarcoma
  - Fibrosarcoma
  - Spine becomes thick & compressed = ↓ height, kyphosis, back pain, SC compression (N/T)
  - Cranium thickens = ↑ hat size, deaf, hydrocephalus, visual deficits, dementia, HA's
- **Treatment:**

- Treat the S/Sx & correct the deformities
- Analgesics, NSAIDS
- Bisphosphonates – slows bone resorption
- Calcitonin – for those who cannot take bisphosphonates
- Radiation – tumors - ↓ pain
- Surgery - fracture and ↓ pain

- **Nursing Diagnoses:**
  - Acute Pain, Impaired Physical Mobility, Risk for Injury - ↑ risk for pathological fractures