Bones, Calcium, and Osteoporosis

Bone Disorders Related to Calcium

• Rickets
  – Defective bone growth from lack of Vitamin D
  – Deformities due to softened bone
• Osteomalacia: Adult form of rickets
• Paget’s Disease
  – Increased Bone resorption
  – Replacement with abnormal bone
  – Most asymptomatic
    • Fractures, deformities, deafness
• Osteoporosis: Demineralization of bone

Osteoporosis

• Demineralization of bone with age
• Demographics
  – 10 million outright, and 34 million with osteopenia
    • Women: 80%
    • Men 20%
• Pathophysiology
  – Maximum bone density ~30 years
  – Stable until ~50
  – Decreases after 50, accelerated for women 1% vs 2-3%
  – Decreased bone deposition occurs with age
  – Loss of calcium deposits and density leads to fragility
Osteoporosis

• Manifestations
  – Loss of height
  – Kyphosis, scoliosis
  – Increased risk of fracture
    • Wrist fractures
    • Compression fractures
    • Femoral neck

• Evaluation
  – X-ray: typically once a fracture is suspected
  – BMD: Dua-energy x-ray absorptiometry (DEXA)
    • Results reported in standard deviations
    • 1SD = 10% bone loss
    • 1 – 2SD below normal = osteopenia
    • < 2.5SD = osteoporosis
    • Site of measurement: wrist, vertebrae, femoral neck
    • BMD is higher predictor of fracture risk than BP of stroke
  – Family Hx of osteoporosis
  – Personal hx of fractures
  – Propensity to fall

• Treatment
  – Prevention!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
  – Prevent bone loss
  – Promote bone formation
  • All three require adequate calcium and
    vitamin D!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Osteoporosis

• Indications
  – Mild hypocalcemia
  – Osteopenia, osteoporosis
• Adverse effects
  – Hypercalcemia with chronic high doses
  – Interactions with some drugs

Calcium salts
**Calcium Salts: Dose/Age**

<table>
<thead>
<tr>
<th>Age</th>
<th>Adequate Level of Calcium Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 – 18</td>
<td>1300 mg daily</td>
</tr>
<tr>
<td>19 – 50</td>
<td>1000 mg daily</td>
</tr>
<tr>
<td>&gt; 51</td>
<td>1200 mg daily</td>
</tr>
</tbody>
</table>

- Must take into account elemental calcium
  - Calcium carbonate (most common)
  - Calcium citrate (best absorbed)
  - Calcium gluconate (most common IV form)
- Orally: no more than 600mg at one time

---

**Vitamin D**

- Sources: Sun and Fortified Milk
  - Older adults often do not get enough Vitamin D
  - Osteoporosis treatment should include Vitamin D supplementation


---

**Calcitonin (Miacalcin)**

- Injection or nasal spray
- Inhibits osteoclasts
- Inhibits resorption of calcium in kidney.
- Used for
  - Treatment of osteoporosis, but not prevention
  - Hypercalcemia

---

**Biphosphonates**

- Structural analogs of pyrophosphonate
- Inhibit resorption of bone
- Therapeutic uses
  - Postmenopausal and glucocorticoid osteoporosis
  - Paget’s disease
- Preparations: 6 on market
  - Alendronate (Fosamax) (weekly or daily)
  - Actonel (weekly or daily)
  - Boniva (monthly)

---

**Biphosphonates**

- Administration considerations
  - Must give on empty stomach (OJ or coffee decreases absorption by 60%)
  - Must stay upright for 30 minutes afterward (GI upset)
  - Can be given either daily or weekly
  - Do not chew or suck on tablet
  - Full glass of water (min 8 oz)
- Adverse effects
  - Esophagitis
<table>
<thead>
<tr>
<th><strong>Raloxifene (Evista)</strong></th>
<th><strong>Teriparatide</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Selective Estrogen Receptor Modifiers</td>
<td></td>
</tr>
<tr>
<td>- Mimics estrogen in bone, lipids, blood clotting</td>
<td></td>
</tr>
<tr>
<td>- Blocks estrogen effects: breast and endometrium</td>
<td></td>
</tr>
<tr>
<td>- Postmenopausal Osteoporosis</td>
<td></td>
</tr>
<tr>
<td>- Adverse effects</td>
<td></td>
</tr>
<tr>
<td>- Fetal Harm</td>
<td></td>
</tr>
<tr>
<td>- Not for use in women who can become pregnant</td>
<td></td>
</tr>
<tr>
<td>- Caution in patients who smoke: DVT</td>
<td></td>
</tr>
<tr>
<td>- Hot flashes</td>
<td></td>
</tr>
<tr>
<td>- Parathyroid hormone</td>
<td></td>
</tr>
<tr>
<td>- Only drug that increase bone formation</td>
<td></td>
</tr>
<tr>
<td>- If given continuously causes bone loss</td>
<td></td>
</tr>
<tr>
<td>- If given intermittently causes bone formation</td>
<td></td>
</tr>
</tbody>
</table>