Lecture notes for Monday December 2, 2002

Outline

• Review
• Bone remodeling
• Bone Fractures
• Calcium homeostasis
• Osteoporosis

Review

• Diaphysis
  o Shaft of a long bone
• Epiphysis
  o Ends of the long bone
• Metaphysis
  o Area of growth in a long bone
  o Difference between epiphyseal plate (hyaline cartilage where growth occurs to the length of the diaphysis) and epiphyseal line that replaces epiphyseal plate after growth stops
• Articular cartilage
  o Thin layer of articular cartilage that covers the epipysis
  o No blood circulation to this tissue
• Periosteum
  o Two layers: outer fibrous layer & inner cellular layer
• Endosteum
  o Lines medullary cavity
• Medullary cavity (marrow cavity)
• Compact bone
  o Reinforced concrete (osteocytes & matrix)
  o Bunch of straws (each straw represents osteon)
  o Can withstand stress along the axis but not from the side
• Spongy bone
  o Trabeculae
  o Can resist stress applied from different directions
  o Spongy network of trabeculae support yellow and red marrow
• Osteoblasts
  o Originate from mitosis of osteogenic cells
  o Secrete organic components of matrix (collegen fibers) that bind the minerals (calcium, phosphate) to form calcified matrix
  o Responsible for laying down the matrix => bone formation
  o B => building cells
  o Located in inner layer of the periosteum and endosteum
• Osteocytes
• Mature osteocytes
  • Cyte = cell
  • Do not secret collagen
  • Maintain the bone matrix
  • Sit in lacunae and communicate via canaliculi
• Osteoclasts
  • Larger cells with many nuclei
  • Secret acids & enzymes that dissolve bony matrix => release calcium and phosphate into blood
  • Located in endosteum and periosteum
  • C => Killing cells

Bone Remodeling
• Occurs at the periosteum & endosteuem
• Osteoblasts build new tissue
• Osteoclasts demolish old tissue
• Functions: renew bone tissue; redistribution of bone matrix along line of mechanical stress
• Bone tissue formation relative to bone resorption (= breakdown of matrix):
  — Youth: formation is greater
  — 20-40’s: about equal
  — from 40’s resorption is greater

Regulation of growth & remodeling
• Dietary intake of calcium & phosphate
• Vitamin D3 (sun light/dietary) => CALCITRIOL => stimulates calcium absorption thru’ gut
• Vitamin C
• Growth and sex hormones
• Parathyroid hormone (PTH)
• Calcitonin

Calcium Homeostasis
• Calcium blood plasma = variable: 9-11 mg/100mL
• Parathyroid hormone (PTH) stimulates osteoclast activity
• Calcitonin inhibits osteoclast activity
**Parathyroid Hormone**
- Responds to drop in calcium levels
- Causes increased bone resorption => stimulates osteoclast activity
- Stimulates secretion of and enhances action of calcitriol
- Decreases rate of calcium excretion via kidneys

**Calcitonin**
- Responds to increase in calcium levels
- Inhibits osteoclast activity
- Increases rate of calcium excretion thru' kidneys
- (accelerates bone deposition)

**OSTEOPOROSIS**
- Porous bones
- Depletion of bone mass/density
- Women 40’s-50’s
- Men 60’s
- Causes fractures: hip, wrist, vertebrae

**Prevention**
- Calcium intake: 1000-1200 mg
- Weight-bearing exercise
- Exposure to sunlight
- Stop smoking
- Reduce alcohol intake

**Bone Fractures**
**Healing stages (Fig 6.11):**
- Alignment & immobilization
- Hematoma
• Callus formation
• Remodeling