Chapter 24

Complications of Aging

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Senescence

- Biological processes that lead to aging
- Begins prior to birth
- Several theories as to cause
- Also refers to period from onset of old age to death

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The Aging Process

- Rate and effects of aging vary among individuals.
- May not match chronological age
- Rate of changes depend on:
  - Genetic makeup
  - Lifestyle
  - Health status
  - Cardiovascular fitness

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The Aging Process (Cont.)

- Overall, women live longer than men.
- General reduction in function occurs throughout body
- Most vulnerable tissues are those that cannot regenerate effectively:
  - CNS
  - Skeletal muscle
  - Cardiac muscle
  - Kidney

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Theories of Aging

- Genetically programmed
  - Apoptosis—programmed cell death —
- “Wear-and-tear”
  - Accumulated wastes
  - Altered proteins
  - Lipofuscin
  - Degenerative changes in collagen
- Random errors during cell mitosis

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Theories of Aging (Cont.)

- Latent viruses
- Increased autoimmune reactions
- Environmental agents
- Free radicals
  - Peroxides
  - Free radicals damage nucleic acids, leading to cancer and other diseases.

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Hormonal Changes

- With the exception of estrogen and testosterone, the level of hormone secretion remains relatively constant.
- Number of tissue receptors decreases
- Speed of hormonal response may diminish

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Reproductive System Changes: Females

- Menopause (average age, 51 years)
  - Ovaries do not respond to FSH and LH
  - Lack of ovulation
  - Declining estrogen and progesterone levels
  - Cessation of menstrual cycle
  - Hot flashes

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Reproductive System Changes: Females (Cont.)

- Mood swings
  - Hormonal changes
  - Social expectations
  - Fatigue
- Dyspareunia—painful sexual intercourse
  - Thinning of vaginal mucosa, loss of elasticity
  - Decreased glandular secretions

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Reproductive System Changes: Males

- Testosterone levels decline gradually.
- Muscle mass decreases.
- Testes decrease in size.
- Sperm production somewhat reduced
- Glandular secretions of prostate decrease
- Benign prostatic hypertrophy (BPH) common

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Changes in Skin and Mucosa

- Some related to genetic factors
- Many based on exposure to sun and weather
- Skin and mucous membranes become thin and more easily damaged.
- Dermis thinner—subcutaneous tissue diminished
- Number of specialized structures declines:
  - Sweat glands
  - Receptors

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Changes in Skin and Mucosa (Cont.)

- Skin dry because of reduced sebum
- Appears wrinkled
  - Elastic fibers reduced
  - Collagen fibers less flexible
- Lesions include skin tags, keratoses, lentigenes
- Hair becomes gray.
  - Melanocytes are reduced in number.
- Thinning of hair
  - Number of hair follicles decreases

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Cardiovascular Changes

- Size and number of cardiac muscle fibers decrease
- Fatty tissue and collagen fibers accumulate.
- Reduced strength of contraction
- Heart valves thicken, become less flexible
- Vascular changes may cause a decrease in oxygen supply to heart
- Cardiac reserve diminished

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Pathologies of the Cardiovascular System

- Arteriosclerosis
  - Loss of elasticity, accumulation of collagen
  - Thickening of arteriolar walls
  - Increased peripheral resistance
  - Tissue ischemia
  - Cause of nonspecific brain changes

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Pathologies of the Cardiovascular System (Cont.)

- Atherosclerosis
  - Hyperlipidemia
  - Promotes accumulation of cholesterol in walls of large arteries
  - Increased peripheral resistance
  - Tissue ischemia
  - Common cause of angina, myocardial infarction, peripheral vascular disease, strokes

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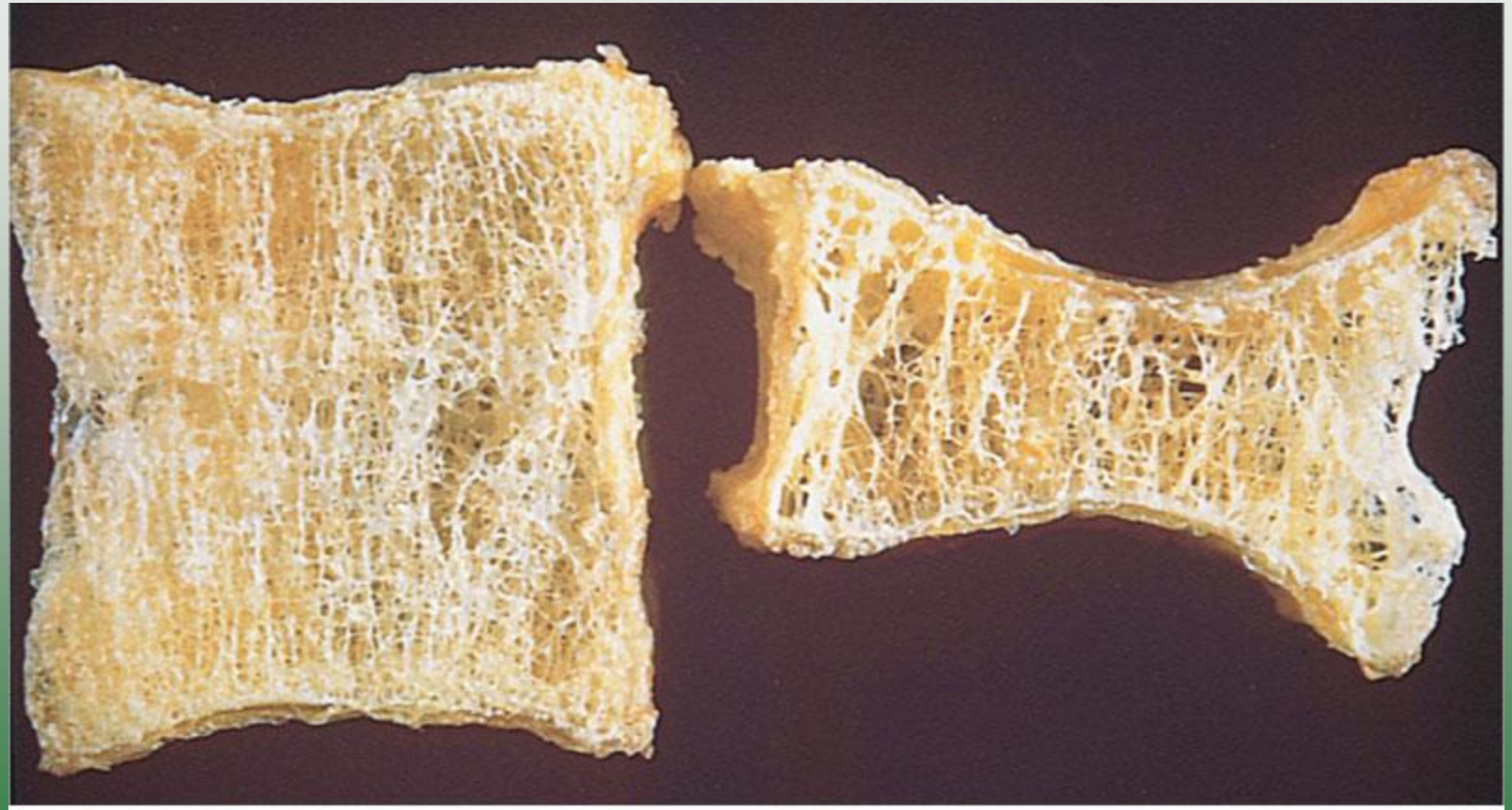
Osteoporotic (Right) and Normal Vertebral Body (Left)



From Kumar V, Abbas AK, Fausto M: Robbins and Cotran: Pathologic Basis of Disease, *ed 7, Philadelphia, 2005, Saunders.*

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Osteoporosis

- Loss of calcium and bone mass
- Higher incidence in postmenopausal women
- Fractures of spine, pelvis, and limbs common
- Risk factors
  - Asian or northern European ancestry
  - Low body mass index
  - Decreased estrogen levels
  - Sedentary or inactive lifestyle
  - Decreased intake of calcium, vitamins C and D
  - Decreased intestinal calcium absorption

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Risk Reduction

- Adequate calcium and vitamin D intake
- Weight-bearing exercises
- Bone density testing for women at age 50 years or earlier

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Osteoarthritis

- Degeneration of cartilage in joints
- May be associated with trauma or sports injuries
- Articular cartilage thins
  - Usually in larger weight-bearing joints
  - Pain and stiffness
  - Joint replacement may be necessary.

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Herniated Intervertebral Disk

- Fibrocartilage in intervertebral disk degenerates with age.
- Loss of height becomes apparent.
- Sudden stress on back may result in herniation.
  - Causes pressure on spinal nerves
  - Results in severe back pain

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Other Musculoskeletal Changes

- Skeletal muscle mass declines with aging.
- Dependent on level of fitness
- Strength of muscle contractions may decrease.
- Flexibility is reduced.
- Stiffness becomes evident.
- Coordination and balance reduced

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Respiratory Changes

- Ventilation is limited.
  - Elasticity in lung tissue is reduced.
  - Costal cartilage calcifies, reducing rib movement
  - Skeletal (intercostal) muscles weaken.
- Expiration is reduced.
  - Residual volume increased
  - Decreased expansion for deep breathing and coughing
- Vascular changes
  - Decreased perfusion
  - Reduced gas exchange in alveoli

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Neurological Changes

- Natural reduction in neurons with aging
- Lipid accumulations in neurons
- Loss of myelin
- Decreased response to neurotransmitters
- Slower response time

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Changes in Vision

- Lens becomes less flexible.
  - Reduced accommodation
- Lens tends to become yellow, less transparent
  - Cataracts develop.
- Night vision reduced
- Color vision may be reduced.
- Vascular degeneration may affect retina

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Other Changes in Sensation

- Hearing loss
  - Usually caused by degenerative changes in inner ear
- Sense of taste may be less
- Decreased sense of smell may become safety issue
- Ability to discriminate among odors is reduced
- Diminished taste and smell sensation may impair appetite and nutrition.

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Gastrointestinal Changes and Nutrition

- Maintenance of good nutrition may be a problem.
- Decreased sense of smell and taste may lead to anorexia
- Older individual may lack money for adequate nutrition
- Muscle weakness and fatigue

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Gastrointestinal Changes and Nutrition (Cont.)

- Obesity in older individuals
  - Increases cardiac workload
  - Atherosclerosis and hypertension
  - Type 2 diabetes

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Gastrointestinal Changes and Nutrition (Cont.)

- Atrophy of mucosa and glands
  - Reduces digestive secretion
  - Impaired absorption of vitamin B_{12}, calcium, and iron
- Constipation common in older adults
  - Frequently leads to hemorrhoids

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Urinary System Changes

- Kidney function reduced
  - Loss of nephrons
  - Diminished ability to adapt to changes in electrolyte and acid levels
  - Reduced capacity to excrete drugs
- Weakened urinary sphincter and bladder
  - Nocturia (frequent urination)
  - Incontinence (involuntary voiding of urine)

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Other Factors

- Infections
  - Delayed healing
    - Reduced rate of mitosis
  - Less rapid immune responses
- Cancer
  - Higher cumulative exposure to carcinogens
- Autoimmune disorders

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Multiple Disorders

- Common in older population
- Integrated treatment for all interacting problems is necessary
- Changes in one system often cause cascade of other problems.
- Synergistic effects

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Multiple Disorders (Cont.)

- Large number of medications common
  - Prescription, herbal, and over-the-counter medications
  - Increased risk of undesirable drug interactions
  - Compliance may be a problem.
  - Often necessary to adjust dosage and drug combinations
    - Unpredictable absorption, distribution, and elimination of drugs

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