

Pathology 375

1. Introduction to pathology

Human body

- The human body is a mass of **cells** that **function** together to maintain their existence
- Cells have a common basic structure
- Cells are organized into tissues
- Tissues are organized within organs
- Organs perform various functions of the body
 - parenchymal tissue performs function of tissue
 - stromal tissue supportive function

Normal cell structure [Fig. 1-1]

Nucleus

- Nucleus contains the instructions for cell function
- Instructions are in form of genetic material
- Genetic material is arranged in genes
- Genes code for proteins
- Production of proteins enable cell to function
- Differentiated cell = perform specialized function
- Undifferentiated cell = no specialized function

Cytoplasm

- Where instructions of the nucleus are implemented
- Contains specialized organelles
 - mitochondria energy source
 - ribosomes protein synthesis
 - endoplasmic reticulum
 - rough ER protein for export
 - smooth ER catabolism, synthesis
 - golgi apparatus packaging of materials
 - lysosomes degradative enzymes

Plasma membrane [Fig. 1-6]

- Protective barrier between internal and external environments
- Communication between internal and external environments

Control of cell function

- Cells act in a coordinated fashion
 - autocrine cell stimulates itself
 - paracrine cell stimulates cell close by
 - endocrine cell stimulates distant cell
- Higher control by the CNS, ANS, PNS

Introduction to pathology

- Pathology = the study of disease
- 4 primary components:
 1. Etiology (cause of the disease)
 2. Pathogenesis (mechanism of the disease)
 3. Morphology (appearance of the disease)
 4. Clinical significance (consequence of the disease)

Cell injury [Fig. 1-8]

- Homeostasis
 - cells perform normal function with balance between internal and external forces (cells in equilibrium)
- Cells are injured when there is a disturbance in the balance between external and internal forces
- Cells adapt to new situation or die
- Outcome of cell response to injury depends on
 - type, duration, severity of injurious force
 - type, state, and adaptability of cell
- Reversible cell injury
 - cell is able to adapt to injurious force
 - remove injurious force, cell reverts to normal
- Irreversible cell injury
 - cell is unable to adapt to injurious force
 - cell dies or is irreversibly damaged

Causes of cell injury

- External forces
 - Lack of oxygen
 - Physical agents (trauma, burn, freeze, radiation, electricity)
 - Chemical agents (drugs, poisons, heavy metals)
 - Infectious agents (bacteria, viruses, parasites)
- Internal factors
 - Immunologic
 - Genetic
 - Metabolic

Example - lack of oxygen [Fig. 1-13]

- Hypoxia decreased oxygen supply
- Anoxia total lack of oxygen
 - without oxygen, brain cells die in a few minutes
 - without oxygen, heart cells die in 1 to 2 hours
- Heart attack: heart stops pumping effectively
 - hypoxia to major organs (eg. brain, and heart)

Introduction to pathology

Cell adaptations to injury [Fig. 1-17]

- **Atrophy**
 - A decrease in the size of cells, tissues, or organs due to altered forces on cells
 - Physiological atrophy
 - atrophy that occurs with aging (eg. Brain)
 - Pathological atrophy
 - atrophy that occurs in response to an injurious force
 - with muscle denervation there is atrophy of skeletal muscle cells supplied by that nerve
- **Hypertrophy**
 - Hypertrophy is an increase in the size of cells, tissues, organs due to altered forces on cells
 - Physiologic hypertrophy
 - skeletal muscle cells enlarge with exercise
 - Pathologic hypertrophy
 - cardiac muscle cells enlarge in response to increased systemic pressure (hypertension)
- **Hyperplasia**
 - Hyperplasia is an increase in the size of tissues, organs due to an increase in the number of cells in response to altered forces on cells
 - Physiologic hyperplasia
 - female breast during pregnancy
 - Pathologic hyperplasia
 - endometrial hyperplasia is an increase in number of cells lining the endometrial cavity
- **Metaplasia**
 - Metaplasia is a form of cellular adaptation characterized by a change of one cell type into another cell type in response to altered forces on cells
 - Chronic smoking, columnar bronchial epithelium changes into stratified squamous
 - Metaplasia is reversible
 - stop smoking then epithelium reverts to columnar
 - Metaplasia may progress to dysplasia if continued exposure to noxious stimulus

Intracellular accumulations

- If a cell is exposed to excess exogenous material or is unable to export endogenous material then that material will accumulate in the cell
- Anthracosis is accumulation of carbon particles in cells in the lungs
- Hemosiderosis is accumulation of hemosiderin in cells
- Steatosis is accumulation of fat in cells

Pathologic calcification

- **Dystrophic calcification**
 - deposition of calcium in damaged tissue (eg. Atherosclerosis)
- **Metastatic calcification**
 - deposition of calcium in normal tissue when there is hypercalcemia

Introduction to pathology

Cell death

- **Necrosis**
 - death of a cell due to external forces with resulting characteristic morphologic changes in the tissue/organ
- **Apoptosis**
 - programmed death of a cell that occurs normally in developing and mature tissue
 - may also occur with drugs/viral infection
- **Coagulative necrosis**
 - morphologic appearance of boiled meat (coagulated protein)
 - most common form of necrosis
 - inactivation of hydrolytic enzymes
 - solid internal organs
- **Liquefactive necrosis**
 - necrosis characterized by dissolution of tissue
 - necrotic area is soft and filled with fluid (Brain infarct)
- **Caseous necrosis**
 - necrotic tissue with appearance of cheese
 - form of coagulative necrosis with limited liquefaction
 - seen in TB
- **Fat necrosis**
 - necrosis of fat due to action of enzymes followed by formation of complexes with calcium
 - white chalky areas form