Introduction to the Human Body: Cells, Tissues, and the Body Compass

Chapter 18

Anatomy and Physiology

- Anatomy: Study of structures and their positional relationships
- Physiology: Study of how the body functions in normal processes
- Pathophysiology (pathology): Study of processes of disease

Medical Terminology

- Medical terms possess one or more parts
  - Root
  - Prefix
  - Suffix
  - Prefixes and suffixes alter meaning of the root

Terminology

- Root: Main part or its foundation
  - Example: cardi- means "heart"
- Prefix: Placed before a root
  - Example: pre- means “before” or “front”
- Suffix: Placed after a root
  - Example: -ectomy means “to cut out,” usually in surgery

Levels of Organization

- Hierarchy based on levels of complexity:
  - Chemical
  - Cellular
  - Tissue
  - Organ
  - Organ system
  - Organism

Cells

- Fundamental unit of all living organisms
- Simplest form of life
- Self-sustaining unit
- Building blocks of human body
- Water makes up 60% to 80% of cells
Cell Membrane

- Separates cytoplasm from external environment
- Semipermeable: Only some materials pass
- City walls

Cytoplasm

- Gel-like intracellular fluid
- Protoplasm provides nutrition
- Supports organelles

Organelles

- Endoplasmic reticulum (ER)
  - Network of membranous channels
  - Transport materials
  - Types: Rough and smooth
  - Mail man and post office

- Ribosomes
  - Small granules of RNA and protein
  - Synthesize protein
  - May bind to ER
  - Construction workers

- Golgi body
  - Packs and stores proteins and lipids until needed
  - Cell’s “packing and shipping” plant

- Mitochondria
  - Site of cellular respiration and provides ATP
  - Cell’s “power plant”

- Lysosomes
  - Engulfs pathogens, cellular debris, and other organelles
  - Contains digestive enzymes
  - Trash company

- Nucleus
  - Large organelle; contains DNA and RNA
  - Has nucleolus for protein synthesis
  - Acts as the control center or “brain” of cell
  - Town hall
Cell Division

- Mitosis
  - Genetically identical daughter cells
  - Epithelial and connective tissues
- Meiosis
  - To produce gametes (sperm or ova)

Passive Processes

- Do not require energy
- Examples:
  - Diffusion (facilitated diffusion)
  - Filtration
  - Osmosis

Diffusion

- Movement of molecules from an area of high concentration to low concentration
  - Continues until distribution is equal
- Facilitated diffusion: Uses carrier proteins or channels to facilitate diffusion

Passive Processes: Osmosis and Filtration

- Osmosis: Movement of a pure solvent (water) through a membrane from an area of low concentration to high concentration
- Filtration: Movement of particles across a membrane due to pressure

Active Transport by Pumps

- Carrier molecules (membrane pumps) move ions in and out of cells
- Ions attach, energy is released, and ions are pumped inside cell
- Examples: Muscle cells and nerve cells

Cellular Metabolism

- Metabolism: Sum total of physical and chemical processes that occur in an organism
  - Needed for growth, repair, and contraction
  - Two phases:
    - Anabolism
    - Catabolism
**Anabolism and Catabolism**

- **Anabolism**
  - Constructive phase
  - Small molecules (amino acids) are converted to large molecules (proteins)

- **Catabolism**
  - Destructive phase
  - Large molecules (carbohydrates) are converted to small molecules (glucose)

**Tissues**

- **Tissues**: Groups of similar cells that act together to perform specific functions

- **Types**:
  - Epithelial
  - Connective
  - Muscle
  - Nervous

**Epithelial Tissue**

- **Lines or covers internal and external surfaces** such as:
  - Skin, organs, vessels, cavities, digestive tract

- **Functions**:
  - Protection
  - Absorption
  - Secretion
  - Excretion

**Types of Epithelium**

- **Endothelium**: Covers internal surfaces of blood and lymphatic vessels

- **Glandular epithelium**: In endocrine and exocrine glands; contains secretory cells

- **Classified as**:
  - Simple epithelium: One cell thick
  - Stratified epithelium: Two or more cells thick

**Subclassifications of Epithelium**

- **Squamous**: Flat-shaped
- **Cuboidal**: Cube-shaped
- **Columnar**: Column-shaped

**Connective Tissue**

- **Most abundant and diverse tissue**

- **Functions**:
  - Connects
  - Supports
  - Transports
  - Defense
Fibrous Connective Tissue

- Packing material of body
- Attaches skin to underlying structures
- Types:
  - Loose (areolar)
  - Adipose
  - Reticular
  - Dense

Loose Fibrous Connective Tissue

- Widely distributed
- Little tensile strength
- Forms subcutaneous layer beneath skin
  (superficial fascia)

Adipose Tissue

- Fatty tissue
- Insulates
- Cushions structures
- Provides fuel reserves

Dense Fibrous Connective Tissue

- Dense irregular fibrous
  - Resists pulling forces in several directions
  - Example: Deep fascia, dermis, periosteum
- Dense regular fibrous
  - More strength than dense irregular
  - Resist pulling forces in two directions
  - Example: Ligaments and tendons

Bone Tissue

- Osseous tissue
- Hardest type of connective tissue
- Permeated by blood vessels and nerves
- Enclosed in periosteum
- Types:
  - Compact
  - Spongy

Bone: Compact and Spongy

- Compact bone
  - Hard outer shell of bone
- Spongy (cancellous) bone
  - Inner, lattice-like part of bone
Cartilage

- Avascular, tough, protective
- Types:
  - Hyaline
  - Fibrocartilage
  - Elastic

Hyaline Cartilage

- Elastic, rubbery, smooth
- Most common type
- Covers articulating surfaces of bones
- Connects ribs to sternum
- Supports nose, trachea, and part of larynx

Fibrocartilage and Elastic Cartilage

- Fibrocartilage
  - Greatest tensile strength
  - Creates disks between vertebrae and in knee
- Elastic cartilage
  - Soft and pliable
  - Found in epiglottis, part of larynx, and auditory tubes
  - Gives shape to nose and ears

Blood

- Blood
  - Red and white cells, and platelets suspended in liquid called plasma
  - Transports respiratory gases, nutrients, and waste products

Muscle Tissue

- Provides movement
- Contracts and extends
- Types:
  - Smooth
  - Skeletal
  - Cardiac

Smooth Muscle

- Involuntary
- Found in walls of hollow organs and blood vessels
- Spindle-shaped cells
- One oval-shaped nucleus
Skeletal Muscle
- Voluntary
- Cigar-shaped cells
- Multinucleate located on cell’s periphery
- Striated

Cardiac Muscle
- Involuntary
- Found in heart wall
- Intercalated disks to synchronize contraction

Nervous Tissue
- Consists of cells called neurons that detect and transmit electrical signals
- Parts of a neuron:
  - Cell body
  - Dendrites
  - Axon

Tissue Repair
- Inflammation
- Regeneration
- Factors that affect tissue repair:
  - Nutrition
  - Good blood circulation
  - Condition of wound

Membranes
- Epithelial
- Connective tissue
- Cutaneous
- Mucous
- Serous
- Synovial

Homeostasis
- Constancy of body’s internal environment
  - Also known as dynamic equilibrium
  - Represents a relatively stable condition within limited range
  - Maintained primarily by neural and hormonal control systems
Anatomic Position

- Body upright and facing forward
- Arms at sides
- Palms facing forward with thumbs to sides
- Feet about hip distance apart
- Toes pointing forward

Body Cavities

- Dorsal cavity
  - Cranial: Contains brain
  - Spinal (vertebral): Contains spinal cord
- Ventral cavity
  - Thoracic: Contains respiratory and cardiac organs
  - Abdominopelvic: Contains abdominal and pelvic cavities

Abdominal Quadrants

- One line lies horizontally and one line lies vertically intersecting at the umbilicus
  - Right upper quadrant
  - Left upper quadrant
  - Right lower quadrant
  - Left lower quadrant

Body Planes

- Sagittal plane (median plane)
  - Bisects body from front to back and divides it into right and left sections
- Frontal plane (coronal plane)
  - Bisects body side-to-side and divides it into anterior and posterior sections
- Transverse plane (horizontal plane)
  - Bisects body horizontally and divides it into superior and inferior sections

Directional Terms

- Left: To the left (the subject’s left)
- Right: To the right
- Superior (cranial, cephalic): Situated above or toward head end
- Inferior (caudal): Situated below or toward tail end
- Anterior (ventral): Pertaining to front
- Posterior (dorsal): Pertaining to back
- Medial: Oriented toward or near midline
- Lateral: Oriented farther away from midline

Directional Terms

- Proximal: Nearer to point of reference
  - Usually toward the trunk
- Distal: Farther from point of reference
  - Usually away from the midline
- Superficial (peripheral): Pertaining to outside surfaces
- Deep: Pertaining to or situated at center of body
Terms Related to Organs and Structures

- Terms are used to describe anatomic relationships among organs or regions within an organ
  - Medulla: Inner region of an organ or structure
  - Cortex: Outer region of an organ or structure
  - Lumen: Space located with a hollow or tubular structure

Regional Terms: Axial Region

- Cephalic: Head
- Cranial: Upper skull
- Temporal: Side of skull
- Facial: Face
- Frontal: Forehead
- Orbital: Eye; ophthalmic means pertaining to the eye
- Zygomatic: Upper cheek
- Nasal: Nose
- Buccal: Cheek wall within the mouth
- Oral: Mouth

Regional Terms: Axial Region

- Otic: Ear
- Mandibular: Lower jaw
- Occipital: Lower back skull
- Cervical: Neck; nuchal means pertaining to the nape or back of the neck
- Thoracic: Chest, area between the neck and diaphragm
- Abdominal: Abdomen; superior region of the abdominopelvic cavity

Regional Terms: Axial Region

- Pelvic: Pelvis; inferior region of the abdominopelvic cavity
- Pectoral: Breast area or upper anterior thorax
- Costal: Ribs
- Umbilical: Navel or central abdomen; pertaining to the umbilical cord
- Vertebral: Spinal column
- Sacral: Sacrum of the spinal column

Regional Terms: Axial Region

- Coccygeal: Bottom of the spinal column or coccyx area; upper region of the gluteal cleft
- Lumbar: Lower back or loin area between the ribs and hips
- Gluteal: Buttocks formed by the gluteal muscles
- Sacroiliac: Between the sacrum and pelvic bones
- Perineal: Between the anus and the genitals

Regional Terms: Upper Extremity

- Clavicular: Collar bone
- Acromial: Top of shoulder
- Scapular: Shoulder blade
- Deltoid: Curve of the shoulder formed by the deltoid muscle
- Axillary: Arm pit
- Brachial: Arm; between the shoulder and elbow
- Antebrachial: Forearm; between the wrist and elbow
- Cubital: Elbow
Regional Terms: Upper Extremity

- Antecubital: Front of the elbow in the bend of the elbow
- Carpal: Wrist
- Palmar: Anterior surface or palm of the hand; volar means pertaining to the palm
- Pollex: Thumb
- Digital: Fingers or toes

Regional Terms: Lower Extremity

- Groin: Area between thigh and abdomen
- Pubic: Genital area over the pubic symphysis
- Coxal: Hip
- Femoral: Thigh; between the hip and knee
- Patellar: Kneecap
- Popliteal: Posterior knee
- Crural: Leg; between the knee and ankle

Regional Terms: Lower Extremity

- Calf: Posterior leg; sural means pertaining to the calf
- Tarsal: Ankle
- Pedal: Foot or feet
- Calcaneal: Heel
- Dorsum: Top of foot
- Plantar: Bottom or sole of foot; volar means pertaining to the sole of the foot
- Hallux: Great toe
- Digital: Toes or fingers; phalangeal means pertaining to the toes or fingers