Chapter 5

The Human Body
Introduction

- A working knowledge of anatomy is important.
- Knowledge of anatomy helps to communicate correct information:
  - To professionals, who know medical terms
  - To others, who may not understand medical terms
Topographic Anatomy

• Superficial landmarks
  – Serve as guides to structures that lie beneath them

• Topographic anatomy applies to a body in the *anatomic position*.
  – Patient stands facing you, arms at side, palms forward.
Planes of the Body

- Imaginary straight lines that divide the body
- Three main areas
  - Coronal plane: front/back
  - Transverse (axial) plane: top/bottom
  - Sagittal (lateral) plane: left/right
Directional Terms

• Important when discussing injury location or pain radiation. Examples include:
  – Anterior (ventral)
  – Posterior (dorsal)
  – Right, left (patient’s right or left)
  – Superior (closest to head)
  – Inferior (closest to feet)
• **Flexion** is the bending of a joint.
• **Extension** is the straightening of a joint.
• **Adduction** is motion toward the midline.
• **Abduction** is motion away from the midline.
• Many structures are bilateral, appearing on both sides of midline.
• Abdomen is divided into quadrants for communication purposes.
  – RUQ
  – LUQ
  – RLQ
  – LLQ
Anatomic Positions

- Prone
- Supine
- Shock
- Fowler
- Recovery
The Skeletal System: Anatomy

- Skeleton gives us our recognizable human form.
- Protects vital internal organs
- Contains
  - Bones
  - Ligaments
  - Tendons
  - Cartilage
The Axial Skeleton

Foundation on which the arms and legs are hung. Includes:

- Skull
- Spinal column
- Thorax
The Axial Skeleton (2 of 4)

• Skull
  – Cranium—made up of 4 bones
  – Face—made up of 14 bones
  – Foramen magnum is the opening at base of skull to allow brain to connect to spinal cord.
The Axial Skeleton (3 of 4)

- Spinal column
  - Composed of 33 bones (vertebrae)
  - Spine divided into 5 sections:
    - Cervical
    - Thoracic
    - Lumbar
    - Sacrum
    - Coccyx
The Axial Skeleton (4 of 4)

- Thorax
  - Formed by 12 thoracic vertebrae and 12 pairs of ribs
  - Thoracic cavity contains
    - Heart
    - Lungs
    - Esophagus
    - Great vessels
The Appendicular Skeleton

- Arms, legs, their connection points, and pelvis
- Includes:
  - Upper extremity
  - Pelvis
  - Lower extremity
The Upper Extremity

• Upper extremity extends from shoulder girdle to fingertips
  – Composed of arms, forearms, hands, fingers
The Upper Extremity (2 of 4)

Shoulder girdle
- Three bones come together, allowing arm to be moved:
  - Clavicle, scapula, humerus
Arm

- The humerus is the supporting bone of the arm.
- The forearm consists of the radius and ulna.
  - Radius on lateral side of forearm
  - Ulna on medial side of forearm
The Upper Extremity (4 of 4)

- Wrist and hand
  - Ball-and-socket joint
  - Principal bones
    - Carpals, metacarpals, phalanges
The Pelvis (1 of 2)

- Closed bony ring consisting of three bones
  - Sacrum
  - Two pelvic bones
- Each pelvic bone is formed by fusion of ilium, ischium, and pubis.
• Posteriorly, the ilium, ischium, and pubis bones are joined by the sacrum
• Anteriorly, the pubic symphysis is where the right and left pubis are joined
The Lower Extremity

- Main parts are thigh, leg, foot.
- Upper leg: femur (thigh bone)
  - Longest bone in body, femur connects into acetabulum (pelvic girdle) by ball-and-socket joint.
  - Greater and lesser trochanter are where major muscles of thigh connect to femur.
• Knee connects upper leg to lower leg
  – Kneecap (patella)
• Lower Leg
  – Tibia (shin bone)
    • Anterior of leg
  – Fibula
    • Lateral side of leg
Ankle
- A hinge joint
- Allows flexion/extension of foot
• Foot
  – Contains 7 tarsal bones
  – 5 metatarsal bones form substance of foot
  – Toes are formed by phalanges
Joints (1 of 2)

- Occur wherever two long bones come in contact
- Two types of joints
  - Hinge joint
    - Motion restricted to one plane
  - Ball-and-socket joint
    - Allows rotation and bending
Joints (2 of 2)

- **Hinge Joint**
- **Ball-and-socket joint**
The Skeletal System: Physiology

The skeletal system:
- Gives body shape
- Provides protection of fragile organs
- Allows for movement
- Stores calcium
- Helps create blood cells
The Musculoskeletal System: Anatomy (1 of 2)

• Musculoskeletal system provides:
  – Form
  – Upright posture
  – Movement

• More than 600 muscles attach to bone.
  – Called skeletal (or voluntary) muscles
Other types of muscle outside the musculoskeletal system
- Smooth muscle
- Cardiac muscle
The Musculoskeletal System: Physiology

- Contraction and relaxation of system make it possible to move and manipulate environment.

- A byproduct of this movement is heat.
  - When you get cold, you shiver (shake muscles) to produce heat.
The Respiratory System: Anatomy

• Structures of the body that contribute to respiration (the process of breathing)
Upper Airway (1 of 2)

• Includes:
  – Nose
  – Mouth
  – Tongue
  – Jaw
  – Oral cavity
Upper Airway (2 of 2)

- Pharynx
  - Nasopharynx
  - Oropharynx
  - Laryngopharynx
    - Larynx is anterior
    - Esophagus is posterior
- Epiglottis
  - Prevents food and liquid from entering trachea
Lower Airway

• Larynx is the dividing line between upper and lower airway.
  – Adam’s apple/thyroid cartilage is anterior.
  – Cricoid cartilage/cricoid ring forms lowest portion of larynx.

• Trachea (windpipe)
  – Ends at carina, dividing into right and left bronchi leading to bronchioles
• The two lungs are held in place by:
  - Trachea
  - Arteries and veins
  - Pulmonary ligaments

• Divided into two lobes
  - Bronchi and bronchioles end with alveoli.
    • Alveoli allow for gas exchange.

• Lungs are covered by smooth, glistening tissue called pleura
Muscles of Breathing

- Diaphragm is primary muscle.
- Also involved are:
  - Intercostal muscles
  - Abdominal muscles
  - Pectoral muscles
The Respiratory System: Physiology (1 of 3)

- Function is to provide body with oxygen and eliminate carbon dioxide.
- Ventilation and respiration are two separate, interdependent functions of the respiratory system.
Respiration is the exchange of oxygen and carbon dioxide in alveoli and tissue.

- Brain stem controls breathing.
- Hypoxic drive is backup system.
- Medulla initiates ventilation cycles.
  - Dorsal respiratory group (DRG)
    - Initiates inspiration
  - Ventral respiratory group (VRG)
    - Provides forced inspiration or expiration when needed
• You provide ventilation when you administer oxygen.
• Tidal volume is amount of air moved into or out of lungs in a single breath.
Characteristics of Normal Breathing

- Normal rate and depth (tidal volume)
- Regular rhythm or pattern of inhalation and exhalation
- Good audible breath sounds on both sides of chest
- Regular rise and fall movement on both sides of the chest
- Movement of the abdomen
Inadequate Breathing Patterns in Adults

- Labored breathing
- Muscle retractions
- Pale, cyanotic, cool, damp skin
- Tripod position
- Agonal respirations (gasping breaths)
The Circulatory System: Anatomy (1 of 2)

- Complex arrangement of connected tubes
  - Arteries, arterioles, capillaries, venules, veins
- Two circuits
  - Systemic circulation—body
  - Pulmonary circulation—lungs
The Circulatory System: Anatomy (2 of 2)

Pulmonary arteries bring oxygen-poor blood from the heart to the lungs.

Pulmonary veins bring oxygen-rich blood from the lungs to the heart.

Superior vena cava

Systemic (body) capillaries

Tissue cells

Venule

Arteriole

Artery

Venin

Aorta

Right atrium

Left atrium

Right ventricle

Left ventricle

Heart

LOWER BODY

UPPER BODY

Inferior vena cava

CO₂

O₂

CO₂

O₂

CO₂

O₂

Systemic (body) capillaries

Pulmonary (lung) capillaries
The Heart (1 of 5)

- Hollow muscular organ the size of an adult’s clenched fist
- Made of specialized cardiac muscle (myocardium)
- Works as two paired pumps
  - Septum divides right and left sides.
The Heart (2 of 5)

• Each side is divided into:
  – Atrium (upper chamber)
  – Ventricle (lower chamber)

• Circulation
  – Heart receives its blood from aorta.
  – Right side receives blood from veins.
  – Left side receives blood from lungs.
The Heart (4 of 5)

- Normal resting heart rate (HR) is 60 to 100 beats/min.
- Stroke volume (SV)
  - Amount of blood moved by one beat
- Cardiac output (CO)
  - Amount of blood moved in 1 minute
  - \( HR \times SV = CO \)
In 1 minute, body’s entire blood volume (5 to 6 L) is circulated through all the vessels.

Electrical conduction network
- Causes smooth, coordinated contractions
- Contractions produce pumping action
Arteries carry blood from heart to all body tissues.
- Branch into arterioles
- Arterioles branch into capillaries

Pulse is created by blood pumping out of left ventricle into major arteries.
Arteries (2 of 2)

- **Major arteries**
  - Aorta (heart)
  - Pulmonary (right ventricle)
  - Carotid (neck)
  - Femoral (thigh)
  - Posterior tibial (lower leg)
  - Dorsalis pedis (foot)
  - Brachial (upper arm)
  - Radial (lower arm)
Capillaries

- Connect arterioles to venules
- Fine end divisions of arterial system
- Allow contact between blood and cells
- Billions of capillaries in body
Veins

- Return oxygen-depleted blood to the heart
- Superior vena cava carries blood returning from head, neck, shoulders, upper extremities.
- Inferior vena cava carries blood from abdomen, pelvis, lower extremities.
- Join at right atrium
Spleen

- Solid organ located under rib cage
- Filters blood
- Is particularly susceptible to injury from blunt trauma
  - Can lead to severe internal bleeding
Blood Composition

- Plasma
- Red blood cells (erythrocytes)
- White blood cells (leukocytes)
- Platelets
• Blood pressure is pressure blood exerts against walls of arteries.
• When left ventricle of heart contracts, it pumps blood from ventricle into aorta.
  – Called systole
• When muscle of ventricle relaxes, ventricle fills with blood.
  – Called diastole

• Blood pressure readings
  – Systolic blood pressure (high point of wave)
  – Diastolic blood pressure (low point of wave)
• Automatically adjusted and controlled
• Perfusion is circulation of blood in organ or tissue in adequate amounts to meet the needs of cells.
• Blood enters organs and tissues through arteries.

• Blood leaves organs and tissues through veins.
Inadequate Circulation in Adults

• The system can adjust to small blood loss.
  – Vessels constrict.
  – Heart pumps more rapidly.

• With a large loss, adjustment fails, and patient goes into shock.
The Function of Blood

- Fighting infection
- Transporting oxygen
- Transporting carbon dioxide
- Controlling pH
- Transporting wastes and nutrients
- Clotting (coagulation)
Sympathetic nervous system is responsible for fight-or-flight response.
- Sends commands to adrenal glands
- Epinephrine and norepinephrine are secreted to stimulate heart and blood vessels.
• Blood vessels have alpha-adrenergic receptors.
• Heart and lungs have beta-adrenergic receptors.
• Parasympathetic nervous system also has effects on cardiovascular system.
  – Addresses actions that do not require immediate response
The Nervous System: Anatomy and Physiology

• The nervous system is perhaps the most complex organ in body

• Consists of:
  – Brain
  – Spinal cord

• Divided into two main portions:
  – Central nervous system (CNS)
  – Peripheral nervous system
Central Nervous System (CNS)  
Brain and spinal cord

Peripheral Nervous System  
Nerves that connect all parts of the body to the brain

Sensory Division  
Conducts sensory information from sense organs and other internal organs to the CNS

Motor Division  
Made up of motor fibers that conduct nerve impulses from CNS to muscles and glands

Sympathetic Division  
Activates body during emergency situations

Parasympathetic Division  
Controls nonemergency functions

Autonomic Nervous System  
Conducts nerve impulses from CNS to organs and glands

Somatic Nervous System  
Conducts nerve impulses from CNS to muscles; voluntary control

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Central Nervous System (1 of 2)

- Brain
  - Controlling organ of the body
  - Subdivisions
    - Cerebrum
    - Cerebellum
    - Brain stem
• Spinal cord
  - Continuation of the brain
  - Transmits messages between brain and body
Peripheral Nervous System
(1 of 2)

- Divided into two main portions:
  - Somatic nervous system
  - Autonomic nervous system
Peripheral Nervous System

(2 of 2)

- Two types of nerves within peripheral nervous system
  - Sensory nerves carry information from body to CNS.
  - Motor nerves carry information from CNS to muscles.
- Somatic nervous system
  - Transmits signals from brain to voluntary muscles (allows for walking, talking)
- Autonomic nervous system
  - Involuntary actions (digestion, dilation)
  - Split into two areas
    - Sympathetic nervous system (fight-or-flight)
    - Parasympathetic nervous system (slows body)
The Integumentary System (Skin): Anatomy (1 of 2)

- Two layers
  - Epidermis (superficial)
  - Dermis (deeper)

- Below the skin lies subcutaneous tissue.
  - Fat that insulates and serves as energy reservoir
The Integumentary System (Skin): Anatomy (2 of 2)
The Integumentary System (Skin): Physiology

- Skin is the largest single organ
- Three major functions
  - Protect the body in the environment
  - Regulate body temperature
  - Transmit information from environment to brain
The Digestive System: Anatomy (1 of 4)

- Function of system is digestion.
- Abdomen is second major body cavity.
  - Contains major organs of digestion and excretion
  - Quadrants are easiest way to identify areas
    - RUQ/LUQ
    - RLQ/LLQ
The Digestive System: Anatomy (2 of 4)
The Digestive System: Anatomy (3 of 3)

- **Mouth**
  - Lips, cheeks, gums, teeth, tongue
  - Salivary glands
- **Oropharynx**
- **Esophagus**
- **Stomach**
- **Pancreas**
- **Liver**
- **Small intestine**
- **Large intestine**
- **Appendix**
- **Rectum**
Enzymes are added to food.
- By salivary glands, stomach, liver, pancreas, small intestine

Enzymes convert food into basic sugars, fatty acids, amino acids.
- Further processed by liver
- Circulated via blood throughout body
The Endocrine System: Anatomy and Physiology

- Complex message and control system
- Integrates many body functions
- Hormones are released directly into bloodstream.
  - Examples: epinephrine, norepinephrine, insulin
The endocrine system controls release of hormones in the body.
The Urinary System: Anatomy and Physiology

- Controls fluid balance in the body
- Filters and eliminates wastes
- Controls pH balance
The Genital System: Anatomy and Physiology (1 of 2)

- Controls reproductive processes
- Male system consists of
  - Testicles
  - Epididymis
  - Vasa Deferentia
  - Penis
• Female system consists of
  – Ovaries
  – Fallopian tubes
  – Uterus
  – Cervix
  – Vagina
Life Support Chain (1 of 3)

- All cells in body require oxygen, nutrients, and removal of waste.
- Circulatory system is the carrier of these supplies and wastes.
- If interference occurs, cells become damaged and die.
• Adenosine triphosphate (ATP)
  – Involved in energy metabolism
  – Used to store energy
• Aerobic metabolism uses oxygen.
• Cells switch to anaerobic metabolism when oxygen is limited.
  – Lactic acid is damaging waste product.
• Movement of oxygen, waste, nutrients occurs by diffusion.
• pH is critical to diffusion.
  – Measure of acidity or alkalinity
• Body spends large amount of energy to maintain normal pH.
Pathophysiology

- The study of functional changes that occur when body reacts to disease
- Respiratory compromise can lead to:
  - Shock
  - Alteration of cellular metabolism
• Understand human anatomy and physiology so you can assess the patient’s condition and communicate with others.
• Know superficial landmarks of the body and what lies underneath the skin.
• Bones, ligaments, tendons, and cartilage give the body its recognizable human form.
• The skeletal system provides protection for organs, allows for movement, and gives the body its shape.
• The contraction and relaxation of the musculoskeletal system gives the body its ability to move.

• The respiratory system includes the nose, mouth, throat, larynx, trachea, bronchi, and bronchioles.
• The function of the respiratory system is to provide the body with oxygen and eliminate carbon dioxide.

• The circulatory system is a complex arrangement of connected tubes, including arteries, arterioles, capillaries, venules, and veins.
• The nervous system is the most complex organ system within the human body. It consists of the brain, spinal cord, and nerves.

• The skin is divided into two parts: the superficial epidermis and the deeper dermis.
• The skin is the largest single organ in the body.
• The skin serves three major functions: to protect the body in the environment, to regulate the temperature of the body, and to transmit information from the environment to the brain.
• The digestive system is composed of the gastrointestinal tract (stomach and intestines), mouth, salivary glands, pharynx, esophagus, liver, gallbladder, pancreas, rectum, and anus.
• The endocrine system is a complex message and control system that integrates many body functions.
• The urinary system controls the discharge of certain waste materials filtered from the blood by the kidneys.
• The genital system controls the reproductive processes.
• Pathophysiology is the study of how the body reacts to diseases.