Lymphatic System

Chapter 21
Functions of Lymphatic System

• Immunity
  – interstitial fluids from all capillary beds are filtered through lymph nodes before returning to circulatory system
  – lymphatic tissues contain immune cells that can respond to dangerous foreign cells or chemicals

• Fluid Recovery
  – absorbs interstitial fluid (2 to 4 L/day) and returns it to the bloodstream
    • interference with lymphatic drainage can lead to edema

• Lipid Absorption
  – Lacteals in small intestine absorb dietary lipids
Lymphatic Circulation
Lymphatic Drainage is Asymmetrical

right side of head, right arm and right upper thorax is drained by right lymphatic duct into the right subclavian vein

thoracic duct drains the rest of the body into the left subclavian vein

nodes are clustered regionally
Lymph and Lymphatic Capillaries

• Lymph
  – clear, colorless fluid, similar to plasma but is more dilute and contains few cells (lymphocytes and macrophages)

• Lymphatic Capillaries
  – closed at one end
  – endothelial cells loosely overlapped
    • allow bacteria and cells to enter lymphatic capillaries
    • overlapping endothelial cells allow inflow of interstitial fluid when pressure is high, and then close when it is low
    • valves keep flow going in one direction
    • found with vascular capillaries
Neurovascular Bundle contains: nerve, artery, vein, lymphatic
Lymphatic Capillary

- Lymph
- Opening
- Tissue fluid
- Endothelium of lymphatic capillary
- Anchoring filaments
Lymph Flow

• Lymph flows at low pressure and low speed
• Mechanisms of lymph flow:
  – weak, rhythmic contractions of lymphatic vessels
  – skeletal muscle contractions: exercise and movement significantly increases lymphatic return
  – thoracic pumping (pressure changes in thorax due to respiratory movements) aids flow
  – valves prevent backward flow
  – rapidly flowing bloodstream in subclavian veins, draws lymph into the venous blood returning to heart
Elephantiasis is a tropical disease caused by lymphatic obstruction.

Mosquito-borne nematode worms infect and block lymphatic vessels leading to chronic edema.

Edema causes fibrosis and a thickening of the skin.

Typically occurs in extremities.
Tissues of the Lymphatic System

1. Lymphatic Organs
   - Lymph Nodes, Tonsils, Thymus, Spleen

2. Lymphatic Nodules
   - Peyer’s Patches are clusters of lymphatic nodules under the epithelium of the small intestine and the large intestine

3. Diffuse Lymphatic Tissue
   - Lymphocytes in mucous membranes and CT of many organs especially in passages open to the exterior like the eyes, ears, nose and throat.
Lymphatic Organ Locations

- **Lymph Nodes**
  - clusters of interconnected lymph nodes are named regionally
  - cervical, axillary and inguinal nodes are close to surface
  - thoracic, abdominal and pelvic nodes are deeper

- **Tonsils**
  - lymphatic tissue that surrounds the entrance to pharynx

- **Thymus**
  - in mediastinum over heart

- **Spleen**
  - inferior to diaphragm on the left side
Lymph Nodes

• Lymph Nodes are the only organs that filter lymph
  – receive and filter all lymph before it returns to the venous circulation

• Cells of lymph nodes include:
  – macrophages that consume dangerous antigens and then present them to lymphocytes
  – lymphocytes respond to specific antigens with specific antibodies
Lymph Node

capsule

cortex

medulla

nodule

germinal center
• Lymphadenitis is indicated by painful nodes called bubos that are greatly enlarged due to rapid proliferation of lymphocytes that are responding to antigens.

• Lymph nodes are common sites for metastatic cancer cells to collect and slowly proliferate causing swollen, firm but usually painless enlarged nodes.
Lymphatic Drainage of Mammary and Axillary Regions

- R. lymphatic duct
- R. subclavian v.
- Axillary lymph nodes
- Lymphatics of breast
Tonsils

• **Palatine Tonsils**
  – tonsils located in the lateral walls of the pharynx
  – most often infected of the tonsils

• **Lingual Tonsil**
  – tonsil in the root of tongue

• **Pharyngeal Tonsil (adenoid)**
  – tonsil in superior surface of the nasopharynx
Palatine Tonsils and Lingual Tonsil(s)
Palatine Tonsils

The deep aspect of each palatine tonsil is isolated from the surrounding connective tissue by a dense fibrous capsule. The surface of a tonsil is covered by a thin, wrinkled epithelium that lines deep crypts in the tonsil. The crypts may contain food debris, bacteria and other antigenic substances. White blood cells can emerge from the crypts to attack antigens.
The thymus secretes the hormones thymopoietin and thymosin that promote development of T lymphocytes.

It is a large, vascular organ for the first decade of life then involutes after about age 14 into fatty, fibrous tissue in adults.
Spleen

• Spleen is composed of two tissues:
  – red pulp: spongy sinuses filled with blood
  – white pulp: clusters of lymphocytes

• Functions
  – blood production in fetus
  – blood reservoir
  – removal of old, damaged RBCs by macrophages
  – filters a large volume of blood to quickly detect antigens

• Capsule is composed of very thin connective tissue that can rupture from mechanical injury (broken rib). Difficult to repair with sutures so sometimes entire organ is removed to control bleeding.
Spleen injury due to motor vehicle collision
Defect closed using part of the greater omentum.