Functions of the lymphatic system

- Production & circulation of lymphocytes
- Protection against pathogens (leukocytes)
- Return of ‘fluid’ from the interstitial space to the rt. atrium of the heart
- Aids in absorption/transport of dietary lipids lipid-soluble vitamins (A,D,K and E)
Components of the lymphatic system

- Spleen
- Thymus
- 5 Tonsils
- Lymph nodes (distributed all over the body)
- Lymphatic vessels
- Peyer’s patches
- lacteals
Lymphocytes

• A type of leukocyte
• Function in specific immunity
• Destroy pathogens
• Travel thru the cardiovascular & lymphatic systems
Types of lymphocytes

• Three types:
  – T cells (thymus-dependent)
  – B (bone marrow derived) cells
  – NK cells (natural killer)
T cells

- 80% of the circulating lymphocytes
- Directly attack pathogens- Cytotoxic T cells
- Control activity of B cells- Helper T cells Suppressor T cells

- Memory T cells-after the primary infection they are on reserve until the same antigen appears in the body

- Affected by Human Immunodeficiency Virus
B cells

• 10-15% of the circulating lymphocytes
• Production of antibodies/immunoglobulins
• Anti bodies bind to antigens (associated with a pathogen)
NK cells

- 5-10% of the circulating lymphocytes
- Destroy pathogens, infected/cancerous cells
Lymphopoiesis
• Occurs in bone marrow and thymus

Fig 23.7
thymus-dependent

bone marrow derived

THYMUS

- Thymic hormones
- Production and differentiation of T cells
- Migrates to thymus
- Mature T cell

RED BONE MARROW

Hemocytoblasts

Lymphoid stem cells

Lympoid cells

B cells

Natural killer cells

PERIPHERAL TISSUES

- Cell-mediated immunity
- Antibody-mediated immunity
- Immunological surveillance
Lymph

• Lymph is the fluid that circulates thru the lymphatic system
• Lymph is similar to plasma of the blood
  – Differences are in the ionic and protein concentrations
• Fluid in the cardiovascular system-plasma
• Fluid in the lymphatic system is-lymph
• Fluid surrounding cells-interstitial fluid
Lymphatic capillaries

• Absorb:
  – Interstitial fluid & dissolved solutes
  – Viruses & bacteria
• Located in most organs the body
  – (not in the skeletal & central nervous system)
• Lacteal-lymphatic capillaries in the intestines that absorb lipids
Fig 23.2

(a) Association of blood capillaries, tissue, and lymphatic capillaries
Lymphatic vessels

• They are similar to veins in the:
  – Layers of the walls (tunics)
  – Internal valves
  – Moving lymph to the heart
    • Skeletal muscle pump
    • Thoracoabdominal (respiratory) pump
    • Internal valves
    • Contraction of lymphatic vessels
Fig 23.3

(a) Lymphatic vessels showing arrangement of valves

(b) Whole mount of lymphatic vessel with valve (LM × 63)

(c) Sectional view

Vein
Artery
Lymphatic vessel
Lymphatic valve

Toward venous system
Major lymph-collecting vessels

- Thoracic (left lymphatic) duct-
  - Collects lymph from areas inferior to the diaphragm & the left side superior to the diaphragm
- Right lymphatic duct-
  - Collects lymph from areas on the right side superior to the diaphragm
• Thoracic duct & Right lymphatic duct empty lymph into the subclavian veins
FIGURE 12-47
The lymphatic system (green) in relation to the cardiovascular system (blue and red). The lymphatic system is a one-way system from interstitial fluid to the cardiovascular system.
Fig 23.4
• Right upper half of the body (right arm, right side of the torso, & right side of the head)

• Tissue (lymph from the interstitial fluid) – lymphatic capillaries-lymphatic vessels-lymph nodes-lymphatic vessels- (the lymph may enter a series of lymph nodes before continuing)—right lymphatic duct-right subclavian vein-----heart
• Everywhere except the right upper half of the body

• Tissue (lymph from the interstitial fluid) – lymphatic capillaries-lymphatic vessels- lymph nodes-lymphatic vessels- (the lymph may enter a series of lymph nodes before continuing)—cisterna chili (lower limbs)- thoracic duct (left lymphatic duct) lt. subclavian vein-----heart
• CV capillaries
  – Net filtration – net absorption = net out flow
• About 2 L/day collected by lymph vessels

(b) Relationship between capillaries and lymph vessels

The excess water and solutes that filter out of the capillary are picked up by the lymph vessels and returned to the circulation.
Fig 25.2

(a) Histological organization of the digestive tract
edema

Blockage of lymphatic capillaries
Lymphatic nodules

- Clusters of many lymphocytes within connective tissue
- Lymphatic nodules in the mouth are tonsils
- Five tonsils
- Lymphatic nodules in the intestinal wall are Peyer’s patches
Fig 25.2

(a) Histological organization of the digestive tract
Fig 25.15

Peyer's patch
Lymph nodes

- Distributed throughout the body
- Located along lymphatic vessels
- Contain a dense pack of lymphocytes and macrophages
- Makes the lymphatic vessels look like a string of beads
Thymus

- Site of T cell maturation
- The blood thymus barrier prevents premature stimulations of developing T cells
- Most active in infancy
- With age undergoes involution (shrinkage)

Largest relative to body size at infancy
Absolute largest at puberty
Spleen

- Between 9th-11th ribs on left side
- Destroys ‘abnormal’ blood cells
- Starts immune response of T & B cells to pathogens in the blood

Regions of the spleen
- White pulp-lymphatic nodules
- Red pulp-contains all component of circulating blood
Lab 14
Fig 23.9