Chapter 15: The Lymphatic System and Immunity  Theory Lecture Outline

Objectives
1. Describe the lymphatic system
2. Define the components of the lymphatic system
3. Outline the function of the lymph nodes
4. Explain what is meant by immunity
5. Identify the causative agents of AIDS
6. List the symptoms of AIDS
7. Describe the modes of AIDS transmission and measures used to prevent its transmission
8. Define the key words that relate to this chapter

Introduction
The lymphatic system consists of a series of vessels that transport fluid (lymph) from the tissues back into the blood. The system includes lymph nodes and lymphoid organs, such as the tonsils, spleen and thymus, that filter the lymph to remove foreign particles as a protection against disease. Lymphoid organs also function in the body’s defense mechanism by enhancing the activities of certain blood cells that produce immunity by inactivating specific pathogenic agents.

Lymphatic System
• Supplements the circulatory system
• Composed of lymph, lymph nodes, lymph vessels, the spleen, the thymus gland, lymphoid tissue in the intestinal tract, and the tonsils
• There is no muscular pump or heart

Functions
• **Lymph fluid** Acts as intermediary between blood and tissue
• **Lymph vessels** Transports excess tissue fluid
• **Lymph nodes** Produce lymphocytes and filters out harmful bacteria
• **Spleen:**
  a. Produces lymphocytes and monocytes
  b. Acts as a reservoir for blood in case of emergency
  c. Works as a recycling plant, destroying and removing old RBCs, preserving the hemoglobin
• **Thymus gland produces T-lymphocytes necessary for the immune system**

Lymph
• Straw colored fluid that diffuses from the capillaries into the tissue spaces
• Called intercellular, interstitial fluid or tissue fluid
• Composition of lymph
  a. Water
  b. Lymphocytes
  c. Some granulocytes
  d. Oxygen
  e. Digested nutrients
  f. Hormones
  g. Salts
  h. Carbon dioxide
  i. Urea
• **Lymph acts as an intermediary between the blood in the capillaries and the tissues**
• Moves with assistance of skeletal tissue contraction, breathing movements, and valves
Lymph Vessels
- Closely parallel the veins
- Lymph vessels are located in almost all the tissues and organs that have blood vessels
- Two large main lymphatics (large lymph vessels)
  a. Right lymphatic duct
     o Lymph from the right arm, right side of the head and upper trunk
  b. Left lymphatic duct (thoracic duct)
     o Receives lymph from the left side of the chest, head, neck, abdominal area and lower limbs
- Flows in only one direction
  a. From the body organs to the heart
  b. Does not flow continually through vessels forming a closed circular route

Lymph Nodes
- Small structures located alone or grouped in various places along the lymph vessels throughout the body
  o Tiny, oval-shaped structures ranging from the size of a pinhead to that of an almond
- Afferent and efferent lymphatic vessels
  a. Lymphatic vessels that carry lymph to a lymph node are called afferent lymphatic vessels
     o About 4 or 5 afferent vessels are associated with each node
  b. Lymphatic vessels that carry lymph out of a node are called efferent vessels
     o A lymph node usually has only one or two efferent vessels
- The lymph nodule surrounds a Germinal centers
  a. When germinal centers are stimulated, the immune response is activated
  b. Any microorganisms or foreign substances in the lymph stimulate the production of lymphocytes, which are then released into the lymph
  c. Eventually, they reach the blood and produce antibodies against the microorganisms
  d. If the harmful substances occur in such large quantities that they cannot be destroyed by the lymphocytes before the lymph node is injured, the node becomes inflamed - adenitis

Tonsils
- Masses of lymphatic tissue capable of producing lymphocytes and filtering bacteria
  a. Produce lymphocytes
  b. Filter out bacteria
- Three pairs of tonsils
  a. Palatine – most common tonsils are located on the sides of the soft palate
  b. Adenoids – located in the upper part of the throat known as adenoids
  c. Lingual – located at the back of the tongue
- Tonsillitis
  o Occurs when the tonsils become infected, enlarged, cause difficulty in swallowing, severe sore throat, elevated temperature and chills

Spleen
- Saeclike mass of lymphatic tissue
- Located upper left of the abdomen beneath the diaphragm
- Forms lymphocytes and monocytes
- Filters out bacteria
- Stores red blood cells
  a. During excessive bleeding or vigorous exercise, the spleen contracts, forcing the stored red blood cells into circulation
  b. It also destroys and removes old or fragile red blood cells, and forms erythrocytes in the embryo
Thymus Gland
- Located in the upper anterior part of the thorax, above the heart
- Produces T-lymphocytes
- Often classified with lymphatic organs but it is also an endocrine gland which secretes a hormone called thymosin, which stimulates production of lymphoid cells

Disorders of the Lymph System
- Lymphadenitis
  - Sometimes called “swollen glands” is an enlargement of the lymph nodes occurring when an infection is present and the body is attempting to fight the infection
- Hodgkin’s disease
- Infectious mononucleosis
  - A disease caused by the Epstein-Barr virus causing enlarged lymph nodes, fever and physical and mental fatigue with a marked increase in leukocytes
  - In some cases the liver may be affected and hepatitis can result

Effects of Aging
- Decline in immune function
- Increased risk of infection
- Decreased ability to fight disease
- Slowed wound healing

Immunity
- When pathogens and foreign materials penetrate the skin the person’s immunity comes into play
- Immunity is the body’s ability to resist these invaders
  - Individuals differ in their ability to resist infection
  - Resistance varies at different times
- Two general types of immunity
  - Natural immunity
    1. Immunity we are born with
    2. Inherited and is permanent
  - Acquired immunity
    1. Reaction that occurs as a result of exposure to invaders
- May be passive or active
  - Passive acquired immunity – acquired artificially by injecting antibodies that will confer (give) temporary protection
  - Active acquired immunity
    o Natural acquired immunity results from having had and recovered from the disease
    o Artificial acquired immunity comes from being inoculated with a suitable vaccine, antigen, or toxoid (e.g. immunizations); the child’s body will thus be stimulated to manufacture its own antibodies
- Immunoglobulin
  - A protein that functions specifically as an antibody

Immunizations: Ages 0 to 6 Table 15-2A pg. 316
- Hepatitis B
- Rotavirus
- Diphtheria, Tetanus, Pertussis
- Haemophilus
- Pneumococcal
- Inactivated poliovirus
- Influenza
- Measles, mumps, rubella
- Varicella
- Hepatitis A
- Meningococcal
Immunizations: Ages 7 to 18 Table 15-2B pg. 317
- Tetanus, diphtheria, pertussis
- Human papillomavirus
- Meningococcal
- Pneumococcal
- Influenza
- Hepatitis A
- Hepatitis B
- Inactivated poliovirus
- Measles, mumps, rubella
- Varicella

Immunizations – Adult Table 15-4A pgs. 319-320
- Tetanus, diphtheria, pertussis (Td/Tdap)
- Human papillomavirus
- Measles, mumps, rubella
- Varicella
- Influenza
- Pneumococcal
- Hepatitis A
- Hepatitis B
- Meningococcal

Autoimmunity
- Autoimmune disorder
  o When the body mistakenly targets the normal cells, tissues, and organs of a person’s own body
- Multiple causes can trigger the disorder
  a. Genetic familial predisposition
  b. Viruses
  c. Even sunlight (triggers lupus)

Autoimmune Disorders
- Multiple sclerosis – potentially debilitating disease in which your body’s immune system eats away at the protective sheath that covers you nerves
- Myasthenia gravis – characterized by varying degrees of weakness of the voluntary (skeletal) muscles of the body caused by a defect in the transmission of nerve impulses to muscles
- Pernicious anemia – condition in which the body can’t make enough healthy red blood cells because it doesn’t have enough vitamin B12 because of a lack of intrinsic factor (protein produced by cells in the stomach lining) in gastric secretions
- Psoriasis – condition causes rapid skin cell reproduction resulting in red, dry patches of thickened skin due to unknown reasons other than genetic predisposition and environmental factors
- Crohn’s disease – inflammatory bowel disease causes have not been proven but the most popular theory is that the body’s immune system reacts abnormally in individuals with Crohn’s disease mistaking bacteria, foods and other substances for being foreign
- Ulcerative colitis – inflammation and sores, called ulcers, in the lining of the rectum and colon
- Type I diabetes mellitus – metabolic disease characterized by high blood sugar levels, that result from defects in insulin secretion, or action or both
- Rheumatoid arthritis – chronic inflammation of the joints
- Lupus – chronic, autoimmune disease that can damage any part of the body (skin, joints and/or organs)
- Scleroderma – disease of the connective tissue featuring skin thickening, spontaneous scarring, blood vessel disease, varying degrees of inflammation, associated with an overactive immune system

Hypersensitivity
- When the body’s immune system fails to protect itself against foreign material
  o Individual’s are generally more sensitive to certain allergens than most people
- Allergens
  a. Antigen that causes allergic responses
  b. Allergens stimulate antibody formation
• Anaphylaxis or anaphylactic shock
  a. Severe allergic reaction if proper care is not given immediately, death may occur in minutes
  b. Result of an antigen-antibody reaction that stimulates a massive secretion of histamine

AIDS/HIV
Disease that suppresses the body’s natural immune defense system
• A – Acquired
  o The disease is not inherited
• I – Immune
  o Refers to body’s natural defenses against cancers, disease, and infections
• D – Deficiency
  o Lacks cellular immunity
• S – Syndrome
  o Involves the set of diseases or conditions that are present to signal the diagnosis
• Human immunodeficiency virus (HIV) causes AIDS
  a. HIV destroys the body’s T4-lymphocyte cells (immune system’s key infection fighters)
  b. Opportunistic infections
    o Infection caused by pathogens that usually do not cause disease in a healthy host
  c. Three outcomes from infection with HIV
    a. AIDS
    b. AIDS-related complex (ARC)
    c. Asymptomatic infection
• HIV/AIDS Statistics
  a. End of 2009 33.3 million people were estimated to be living with HIV
  b. Estimated 2.6 million people became newly infected with HIV in 2009
  c. Estimated 370,000 children were newly infected with HIV in 2009 via mother-to-child transmission
  d. 1.8 million deaths worldwide from AIDS-related complications in 2009
  e. In 2009 alone, 1.2 million people received HIV antiretroviral therapy
  f. The CDC issued new guidelines, calling for everyone between the age of 13 and 64 to be screened for the virus, to allow for earlier detection and more effective treatment

Transmission of AIDS
• Sexual contact
• Sharing hypodermic needles
• In utero or at birth
• Blood transfusions however effective screening methods have virtually eliminated this
Health care workers following appropriate precautions are at very little risk of contracting HIV
• Scientists have found no evidence that HIV is spread through sweat, tears, urine or feces
  o Fragile virus that cannot survive outside the body

Screening Tests for HIV/AIDS
• ELISA – detects the antibodies for AIDS
• Western blot – follow-up test to confirm ELISA results
• Rapid test – detects the presence of antibodies to HIV in approximately 20 minutes

Symptoms of HIV/AIDS
• Flu-like symptoms
• More persistent symptoms develop over time
  o Even though there are often no symptoms the HIV-infected person can still transmit the disease
• Opportunistic conditions
a. Cancers
b. Parasitic infections
c. Fungal infections
d. Viral infections
e. Tuberculosis and syphilis

Treatment of HIV/AIDS
- No cure for AIDS
- Prevention and treatment have prolonged and improved the lives of many
  a. AZT – blocks viral replication
  b. Protease inhibitors – prevents HIV from becoming functional
  c. AIDS cocktail – combination of AZT and protease inhibitors
- Current research has found HIV-neutralizing antibodies that could play a key role in development of a vaccine

Preventing Transmission of HIV/AIDS
Most important methods in the prevention of AIDS are education and training
- Limit sexual contacts
- Have protected sex
- Do not share needles
- Clean up soiled materials
- Cover wounds
- Standard precautions used by all health care workers