Chapter 22: Lymphatic System and Immunity

I. Lymphatic System

A. Functions of the Lymphatic System - list and describe:

1. _____
   _____
   _____
   _____
   _____
   _____
2. _____
   _____
   _____
   _____
3. _____
   _____
   _____

B. Lymphatic Vessels

1. What are lymphatic capillaries? _____
2. Lymphatic capillaries differ from blood capillaries in that:
   a. Lack _____
   b. Cells of the epithelium _____ & _____
3. Because of the structure of lymphatic capillaries:
   a. Far more _____
   b. Nothing _____
   c. Epithelium functions as _____
4. Lymphatic capillaries join to form larger _____
   a. These resemble _____ in structure
5. Lymphatic vessels contain _____ similar to those in veins
6. When a lymphatic vessel is compressed _____
   as a result the lymph moves _____
7. What three factors are responsible for the compression of lymphatic vessels?

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a. _____
b. _____
c. _____

8. Lymph Nodes
   a. Describe the shape of a lymph node _____
   b. Functionally lymph nodes _____
9. After passing through the lymph nodes the lymphatic vessels converge to form larger vessels called _____
   a. Indicate what part of the body is drained by each of the lymphatic trunks:
      1. Jugular trunks _____
      2. Subclavian trunks _____
      3. Bronchomediastinal trunks _____
      4. Intestinal trunks _____
      5. Lumbar trunks _____
   b. Lymphatic trunks:
      1. Connect to _____ OR
      2. Join to form yet larger vessels called _____
10. The two major lymphatic ducts are:
    a. Right lymphatic duct that is _____ in length and drains:
       1. Right side _____
       2. Right _____
       3. Right _____
    b. Thoracic duct that is _____ in length and drains:
       1. Right side of the body inferior _____
       2. Entire left _____
11. What are cisterna chyli? _____

C. Lymphatic Tissues and Organs
   1. Lymphatic tissue consists primarily of _____ but also includes _____, _____, & _____
   2. In response to microbes or foreign substances, the lymphocytes:
      a. _____

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b. Increase _____

c. Part of the _____

3. What are reticular fibers? _____
   a. Lymphocytes and other cells _____
   b. The fiber network _____ & _____
4. What are mucosa-associated lymphoid tissues (MALT)? _____

   _____
5. Diffuse Lymphatic Tissue and Lymphatic Nodules
   a. Contains _____, _____, & _____
   b. Has no clear _____ and _____
   c. It is located:
      1. Deep to _____
      2. Around _____
      3. Within the _____ & _____
   d. What are lymphatic nodules? _____

      _____
      1. Where are they numerous? _____

         _____
      2. What are Peyer's patches? _____

         _____
      3. What are lymphatic follicles? _____
6. Tonsils
   a. What are tonsils? _____

      _____
   b. Tonsils provide protection against _____
   c. Where are the palatine tonsils? _____
   d. Where are the pharyngeal tonsils? _____
   e. Where are the lingual tonsils? _____
7. Lymph Nodes
   a. Where are superficial lymph nodes? _____
   b. Where are deep lymph nodes? _____

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c. A capsule composed of _____ surrounds a lymph node
d. What are trabeculae? _____
e. Reticular fibers _____
f. What are lymphatic sinuses? _____
g. Describe the cortex of a lymph node: _____

_____

h. Describe the medulla of a lymph node: _____

_____

i. Afferent lymphatic vessels carry _____
j. Efferent lymphatic vessels carry _____
k. What do macrophages do to lymph? _____

_____

l. What happens at a germinal center? _____

_____

_____

8. Spleen
   a. Roughly the size of _____
   b. The outer capsule is composed of _____
   c. Trabeculae are composed of _____
   d. Trabeculae subdivide the spleen into _____
   e. White pulp is associated with _____
   f. Red pulp is associated with _____
   g. What is the periarterial lymphatic sheath? _____

      _____

   h. What are the splenic cords? _____
   i. What are the venous sinuses? _____
   j. Blood flows through the spleen at _____
   k. Functionally the spleen:
      1. Destroys defective _____
         a. Old red blood cells can rupture _____

            _____

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b. Splenic macrophages _____

2. Detects and responds to _____
   a. Stimulate an _____ because of specialized lymphocytes in the _____
   b. High concentrations of T cells in _____
   c. High concentrations of B cells in _____
3. Acts as a blood _____
   a. During exercise splenic volume _____
   b. Increase in circulating red blood cells can promote _____ to _____ during _____ or _____

9. Thymus
   a. Where is the thymus located _____
   b. The thymus is a _____ gland
   c. The thymus is surrounded by a thin _____
   d. Lobules are formed by _____ that extend _____
   e. The framework of the thymus consists of _____
      1. The cells are joined by _____
      2. Form small, _____ filled with _____
   f. Describe the cortex: _____
   g. Describe the medulla: _____
   h. What are thymic corpuscles? _____
   i. The thymus is the site of maturation for _____
   j. Large numbers _____ but most _____
   k. The lymphocytes that survive maturation are capable of:
      1. Reacting _____
      2. Normally they do not _____

II. Immunity

A. What is immunity? _____
   1. Innate immunity is also called _____
   2. Adaptive immunity is also called _____
   3. Specificity and memory are characteristics of _____

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4. What is specificity? _____
5. What is memory? _____
6. In innate immunity:
   a. Each time _____
   b. The response is _____
   c. Because _____
7. In adaptive immunity:
   a. Response during the second exposure is _____ than _____
   b. Because the immune system _____

III. Innate Immunity

A. Mechanical Mechanisms
   1. Form barriers that prevent _____
      a. Such as the _____ & _____
   2. Remove _____ & _____ from the surface
      a. Washed from the eyes by _____
      b. Washed from the mouth by _____
      c. Washed from the urinary tract by _____
      d. Ciliated mucous membranes _____ to the _____ where they _____
      e. Microbes are also removed from the respiratory tract by _____ & _____

B. Chemical Mediators
   1. Some found on the surface of cells kill _____
   2. Other chemical mediators promote inflammation by
      a. Causing _____
      b. Increasing _____
      c. Attracting _____
      d. Stimulating _____

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3. Complement
    a. Complement is a group of _____
    b. What is the complement cascade? _____
    c. The alternative pathway is part of _____
        1. Initiated when _____
        2. If activated C3 combines with _____ it becomes _____ and activates _____
    d. What is a membrane attack complex (MAC)? _____
    _____
        1. What happens because of the hole? _____
        _____
        2. What does lysozyme do in conjunction with MAC? _____
        _____
    e. Complement proteins can attach to bacteria and stimulate _____
    f. Complement proteins also:
        1. Attract _____
        2. Promote _____
4. Interferons
    a. Interferons are proteins that _____
    b. Viruses stimulate an infected cell to _____
    c. Interferons bind to the _____
        1. This stimulates the neighboring cells to produce _____
        2. This stops viral reproduction by _____
    d. Interferons act against _____
    e. Interferons also play a role in _____

C. Cells
1. White blood cells are the most important _____
2. What are chemotactic factors? _____
_____
    a. Important examples include:
        1. _____

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2. _____
3. _____
4. _____

3. How are chemotactic factors spread? _____
4. White blood cells follow chemotactic factors by moving from areas of _____ concentration to areas of _____ concentration
   a. This ability is called _____
5. Describe the ameboid movement of white blood cells: _____
   _____
6. What happens in phagocytosis? _____
   _____
7. Neutrophils
   a. Neutrophils are _____
   b. Neutrophils are usually the _____ and they often _____
   c. Neutrophils also release _____ that
      1. Kill _____
      2. Cause _____ damage
      3. Cause _____
   d. Pus is an accumulation of _____
      _____
8. Macrophages
   a. Macrophages are _____ that leave blood, enter _____ enlarge _____, & increase _____
   b. Macrophages are _____ phagocytic cells that
      1. Outlive _____
      2. Ingest _____ & _____
   c. Usually accumulate in tissue _____
   d. Responsible for _____
   e. Macrophages enhance the immune response by producing a variety of chemicals such as: _____, _____, & _____

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f. Macrophages are located just beneath the free surfaces of the body to provide _____

g. Macrophages are also located within _____ called _____

1. These macrophages are now called the:

_____

9. Basophils, Mast Cells, and Eosinophils

a. Basophils are motile white blood cells that _____

b. Mast cells are non-motile cells in _____

1. Located at potential _____

c. When activated basophils and mast cells:

1. Release _____ such as _____ & _____

a. Produce _____

b. Activate _____

d. Eosinophils

1. Eosinophils release enzymes that _____

2. Mechanism to contain and _____

3. Eosinophil numbers greatly increase in patients with _____

_____

4. Eosinophils also secrete enzymes that _____

10. Natural Killer (NK) Cells

a. Natural killer cells are a type of _____

b. The attack classes of cells such as _____ & _____

c. NK cells kill their target cells by using _____

D. Inflammatory Response

1. What is the inflammatory response? _____

_____

2. Damage to tissues cause the release or activation of _____ such as:

a. _____

b. _____

c. _____

d. _____

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e. _____ & others

3. What effects are produced by the chemical mediators?
   a. _____
   b. _____
   c. _____
4. How is the infected area walled off? _____
5. Complement:
   a. Further _____
   b. Attracts _____
6. The process continues until _____
7. Finally phagocytes _____ and the tissue _____
8. What is local inflammation? _____
   a. Symptoms of local inflammation include: _____, _____, _____, _____, & _____
9. What is systemic inflammation? _____
   a. Three additional features of systemic inflammation are:
      1. Red bone marrow _____
      2. Pyrogens are released by _____
         a. Pyrogens stimulate _____
      3. Large amounts of fluid _____
         a. Decreased blood volume can cause _____ & _____

IV. Adaptive Immunity

A. General

1. Adaptive immunity involves _____ _____
2. What are antigens? _____
3. What are haptens? _____
4. Foreign Antigens
   a. Antigens not produced by the body but _____

b. Examples of foreign antigens include: _____

_____

_____

c. What is an allergic reaction? _____

d. Foreign antigens in transplanted tissues and organs result in

_____

5. Self-antigens
   a. Molecules produced by the body that stimulate _____
   b. What is an autoimmune disease? _____
6. Antibody-Mediated Immunity (formerly Humoral Immunity)
   a. B cells give rise to _____ that produce _____ found in

   _____
7. Cell-Mediated Immunity
   a. Different subpopulations of T cells are responsible for particular aspects:
      1. Effector T cells such as:
         a. _____
         b. _____
            1. Responsible for producing _____
      2. Regulatory T cells such as:
         a. _____
         b. _____
            1. Can promote or inhibit _____

B. Origin and Development of Lymphocytes
   1. In the red bone marrow:
      a. Some stem cells give rise to pre-T cells
         1. Pre-T cells migrate _____
         2. The pre-T cells divide and _____
            a. What is the function of thymosin? _____
      b. Other stem cells produce _____
         1. Processed in the red bone marrow into _____

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2. What happens in the positive selection process? _____

   _____

3. What is a clone of lymphocytes? _____

   _____

   a. Each clone can respond only to a _____

4. What happens in the negative selection process? _____

   _____

5. T cells and B cells continually circulate between the _____ &

   _____

6. The primary lymphatic organs are the sites where _____

   a. These organs are the _____ & _____

7. The secondary lymphatic organs and tissues are the sites where _____

   _____

   a. These include the _____, _____,

      _____, _____, & _____

C. Activation of Lymphocytes

1. The two general principles of lymphocyte activation are:

   a. _____

   b. _____

2. Antigenic Determinants and Antigen Receptors

   a. What must happen for an adaptive immune response to occur?

      _____

   b. The portion of an antigen recognized by a lymphocyte is called:

      _____ or _____

   c. The portion of a lymphocyte that reacts with the antigen is called:

      _____

      1. The T cell receptor consists of 2 _____ subdivided into a _____ & a _____ region
         a. Which part binds to the antigen? _____
      2. The B-cell receptor consists of 4 _____ with 2 _____ regions

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3. Major Histocompatibility Complex Molecules
    a. Most lymphocyte activation involves glycoproteins on the surfaces of cells called _____
    b. MHC molecules have a variable region that can bind to _____
    c. MHC Class I Molecules
        1. Are found on nucleated cells and function to _____
        _____
        2. MHC class I/antigen complexes on the surface of cells can:
            a. Bind to _____
            b. This combination _____
            c. Activated T cells can _____
            d. Effectively stopping _____
        3. What does MHC-restricted mean? _____
        _____
    d. MHC Class II Molecules
        1. Are found on _____ which include:
            a. _____
            b. _____
            c. _____
            d. _____
        2. What are dendritic cells? _____
        3. Antigen-presenting cells are specialized to:
            a. Take _____
            b. Process _____
            c. Use _____
            d. To display _____
                1. MHC class II/antigen complex can _____
            e. The displaying cell _____ destroyed
            f. Stimulates other immune cells _____
4. Costimulation
    a. Needed to _____ in B cells and T cells

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b. Costimulation is accomplished by:
   1. _____
   2. _____

c. What are cytokines? _____

_____

d. Certain pairs of molecules can also be involved in costimulation:
   1. When the surface molecule on one cell combines with _____

      _____
   2. The combination can act as:
      a. Signal _____
      b. Can hold _____

5. Lymphocyte Proliferation
   a. Proliferation of Helper T cells
      1. How is the antigen presented? _____
      2. What helper T cells can respond to this presentation? _____
      3. How do the helper T cells respond to activation? _____
   b. Proliferation and Activation of B or Effector T cells
      1. B cells present processed antigen on surface with _____
      2. What responds to this presentation? _____
      3. These cells then stimulate the B cells to _____

D. Inhibition of Lymphocytes
   1. What is tolerance? _____
   2. The most important function of tolerance is _____

      _____
   3. List and describe three ways tolerance can be induced:
      a. _____

      _____

      _____

      b. _____

      _____

      _____

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c. _____

_____

E. Antibody-Mediated Immunity

1. Effective against _____
2. Antibodies
   a. Antibodies are _____
   b. Antibodies are what portion of plasma proteins? _____
   c. Antibodies are also known as _____
   d. Each antibody is composed of _____
      1. Two _____ and
      2. Two _____
   e. Where is the variable region? _____
   f. The variable region is responsible for? _____
   g. What is the constant region responsible for? _____

      _____
3. Effects of Antibodies
   a. Antibodies can directly affect antigens in two ways:
      1. Can bind to _____
      2. Can combine with _____
   b. Antibodies can indirectly affect antigens by:
      1. Activate the _____
      2. Initiate an _____
      3. Act as an opsonin by:
         a. Connecting to _____
         b. Connect to a macrophage _____
         c. Then the macrophage _____
4. Antibody Production
   a. Primary Response
      1. Response to the _____ exposure to a specific antigen
      2. Antigen binds to B cell receptors on _____
      3. Activation causes the small lymphocyte B cell to undergo _____

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_____

4. Some of the cells become:
    a. Plasma cells that _____
    b. Others revert back _____ & become _____
5. How long does it take to produce enough antibodies to be effective against the antigen? _____
6. Disease symptoms develop because _____

b. Secondary or Memory Response
1. Occurs when _____
2. Results from _____ which
    a. Rapidly _____ and
    b. Large amounts of _____
3. Provides better protection for two reasons:
    a. Time required _____
    b. Amount of _____
4. Antigen is quickly destroyed, _____, & _____
5. The memory response also forms _____

F. Cell-Mediated Immunity
1. Function of T cells and is most effective against _____
2. Activation of T cells is regulated by:
    a. _____
    b. _____
3. Once activated T cells go through a series of divisions and produce:
    a. _____ such as _____
    b. _____
4. Functionally effector T cells are responsible for _____
5. Functionally memory T cells are responsible for _____
6. Cytotoxic T Cells
    a. Contact antigens on the surface of a cell:
        1. _____ on virus-infected cells

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2. _____ on tumor cells
3. _____ on transplanted tissues

b. When the cytotoxic T cell binds with its target cell:

1. Releases chemicals that _____
   a. How does perforin work? _____
      _____
2. Can also release cytokines that _____

7. Delayed Hypersensitivity T Cells
   a. Respond to antigens by _____
      1. Promote _____ &
      2. _____ especially in _____

V. Immunotherapy

A. Immunotherapy treats disease by _____ or _____

1. Some approaches attempt _____
2. Sometimes inhibiting _____

B. Monoclonal Antibodies

1. Producing monoclonal antibodies may result in _____ _____
2. What is the major problem with monoclonal antibodies? _____ _____
3. What is humanization? _____
   a. What is its purpose? _____

VI. Acquired Immunity

A. Terminology

1. List the four ways of acquiring adaptive immunity:
   a. _____
   b. _____
   c. _____

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d. _____

2. What does the term natural imply? _____
3. What does the term artificial imply? _____
4. What does active immunity mean? _____
5. What does passive immunity mean? _____
6. Which is longer lasting immunity, active or passive? _____

B. Active Natural Immunity
   1. Is the result of natural _____
   2. The first exposure usually causes _____

C. Active Artificial Immunity
   1. An antigen is deliberately _____
      a. The process is called _____
      b. The introduced antigen is called a _____
   2. The vaccine usually contains:
      a. Some part _____
      b. Dead _____ or a live, _____
   3. The vaccine is designed to stimulate an immune response but _____

      _____
   4. Why is this a preferred method of acquiring adaptive immunity? _____

      _____

D. Passive Natural Immunity
   1. Results from the transfer of _____

      _____
   2. Antibodies can also be transferred to the newborn in the _____

E. Passive Artificial Immunity
   1. Begins with vaccinating an _____
   2. Antibodies are then removed _____

      _____
   3. Sometimes a human who has developed _____

      _____
   4. Provides immediate _____ but is only _____

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5. What is antiserum? _____

_____

VIII. Effects of Aging on the Lymphatic System and Immunity

A. What effect does aging have on the lymphatic system? _____

_____

B. What effect does aging have on helper T cells? _____

_____

C. Antibody Responses
   1. Primary and secondary responses _____
   2. _____ is needed to produce a response
   3. Response is _____
   4. Less _____
   5. Fewer _____
   6. So the ability to resist infections _____

D. Cell-Mediated Immunity
   1. The ability to resist intracellular pathogens _____
   2. Pathogens not eliminated from the body can be reactivated when _____

      _____

      a. A common example is chicken pox appearing later as _____

E. Are new autoimmune diseases common in the elderly? _____
   1. Increased incidence of cancer in the elderly is assumed _____

      _____

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