

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?

- 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. _____

- 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? _____

- 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 _____

- 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 _____

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 _____

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. _____

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: _____, _____, & _____

- 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. _____

- 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 _____

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

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

- 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. _____

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

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. _____

- 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 _____

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 _____
