42.E: The Immune System (Exercises)

42.1: Innate Immune Response

The immune system comprises both innate and adaptive immune responses. Innate immunity occurs naturally because of genetic factors or physiology; it is not induced by infection or vaccination but works to reduce the workload for the adaptive immune response. Both the innate and adaptive levels of the immune response involve secreted proteins, receptor-mediated signaling, and intricate cell-to-cell communication.

Review Questions

Which of the following is a barrier against pathogens provided by the skin?

1. high pH
2. mucus
3. tears
4. desiccation

D

Although interferons have several effects, they are particularly useful against infections with which type of pathogen?

1. bacteria
2. viruses
3. fungi
4. helminths

B

Which organelle do phagocytes use to digest engulfed particles?

1. lysosome
2. nucleus
3. endoplasmic reticulum
4. mitochondria

A

Which innate immune system component uses MHC I molecules directly in its defense strategy?

1. macrophages
2. neutrophils
3. NK cells
4. interferon

C

Free Response

Different MHC I molecules between donor and recipient cells can lead to rejection of a transplanted organ or tissue. Suggest a reason for this.

If the MHC I molecules expressed on donor cells differ from the MHC I molecules expressed on recipient cells, NK cells may identify the donor cells as "non-self" and produce perforin and granzymes to induce the donor cells to undergo apoptosis, which would destroy the transplanted organ.

If a series of genetic mutations prevented some, but not all, of the complement proteins from binding antibodies or pathogens, would the entire complement system be compromised?

The entire complement system would probably be affected even when only a few members were mutated such that they could no longer bind. Because the complement involves the binding of activated proteins in a specific sequence, when one or more proteins in the sequence are absent, the subsequent proteins would be incapable of binding to elicit the complement's pathogen-destructive effects.

42.2: Adaptive Immune Response

The adaptive, or acquired, immune response takes days or even weeks to become established—much longer than the innate response; however, adaptive immunity is more specific to pathogens and has memory. Adaptive immunity is an immunity that occurs after exposure to an antigen either from a pathogen or a vaccination. This part of the immune system is activated when the innate immune response is insufficient to control an infection.
Review Questions

Which of the following is both a phagocyte and an antigen-presenting cell?

1. NK cell
2. eosinophil
3. neutrophil
4. macrophage

D

Which immune cells bind MHC molecules on APCs via CD8 coreceptors on their cell surfaces?

1. TH cells
2. CTLs
3. mast cells
4. basophils

B

What “self” pattern is identified by NK cells?

1. altered self
2. missing self
3. normal self
4. non-self

B

The acquired ability to prevent an unnecessary or destructive immune reaction to a harmless foreign particle, such as a food protein, is called ________.

1. the TH2 response
2. allergy
3. immune tolerance
4. autoimmunity

C

A memory B cell can differentiate upon re-exposure to a pathogen of which cell type?

1. CTL
2. naïve B cell
3. memory T cell
4. plasma cell
Foreign particles circulating in the blood are filtered by the ________.

1. spleen  
2. lymph nodes  
3. MALT  
4. lymph

**Free Response**

Explain the difference between an epitope and an antigen.

An antigen is a molecule that reacts with some component of the immune response (antibody, B cell receptor, T cell receptor). An epitope is the region on the antigen through which binding with the immune component actually occurs.

What is a naïve B or T cell?

A naïve T or B cell is one that has not been activated by binding to the appropriate epitope. Naïve T and B cells cannot produce responses.

How does the T$_{H1}$ response differ from the T$_{H2}$ response?

The T$_{H1}$ response involves the secretion of cytokines to stimulate macrophages and CTLs and improve their destruction of intracellular pathogens and tumor cells. It is associated with inflammation. The T$_{H2}$ response is involved in the stimulation of B cells into plasma cells that synthesize and secrete antibodies.

In mammalian adaptive immune systems, T cell receptors are extraordinarily diverse. What function of the immune system results from this diversity, and how is this diversity achieved?

The diversity of TCRs allows the immune system to have millions of different T cells, and thereby to be specific in distinguishing antigens. This diversity arises from mutation and recombination in the genes that encode the variable regions of TCRs.

How do B and T cells differ with respect to antigens that they bind?

T cells bind antigens that have been digested and embedded in MHC molecules by APCs. In contrast, B cells function themselves as APCs to bind intact, unprocessed antigens.

Why is the immune response after reinfection much faster than the adaptive immune response after the initial infection?

Upon reinfection, the memory cells will immediately differentiate into plasma cells and CTLs without input from APCs or T$_{H}$ cells. In contrast, the adaptive immune response to the initial infection requires time for naïve B and T cells with the appropriate antigen specificities to be identified and activated.
42.3: Antibodies

An antibody, also known as an immunoglobulin (Ig), is a protein that is produced by plasma cells after stimulation by an antigen. Antibodies are the functional basis of humoral immunity. Antibodies occur in the blood, in gastric and mucus secretions, and in breast milk. Antibodies in these bodily fluids can bind pathogens and mark them for destruction by phagocytes before they can infect cells.

Review Questions

The structure of an antibody is similar to the extracellular component of which receptor?

1. MHC I
2. MHC II
3. BCR
4. none of the above

C

The first antibody class to appear in the serum in response to a newly encountered pathogen is ________.

1. IgM
2. IgA
3. IgG
4. IgE

A

What is the most abundant antibody class detected in the serum upon reexposure to a pathogen or in reaction to a vaccine?

1. IgM
2. IgA
3. IgG
4. IgE

C

Breastfed infants typically are resistant to disease because of ________.

1. active immunity
2. passive immunity
3. immune tolerance
4. immune memory
Free Response

What are the benefits and costs of antibody cross reactivity?

Cross reactivity of antibodies can be beneficial when it allows an individual's immune system to respond to an array of similar pathogens after being exposed to just one of them. A potential cost of cross reactivity is an antibody response to parts of the body (self) in addition to the appropriate antigen.

42.4: Disruptions in the Immune System

A functioning immune system is essential for survival, but even the sophisticated cellular and molecular defenses of the mammalian immune response can be defeated by pathogens at virtually every step. In the competition between immune protection and pathogen evasion, pathogens have the advantage of more rapid evolution because of their shorter generation time and other characteristics.

Review Questions

Allergy to pollen is classified as:

1. an autoimmune reaction
2. immunodeficiency
3. delayed hypersensitivity
4. immediate hypersensitivity

D

A potential cause of acquired autoimmunity is ________.

1. tissue hypersensitivity
2. molecular mimicry
3. histamine release
4. radiation exposure

B

Autoantibodies are probably involved in:

1. reactions to poison ivy
2. pollen allergies
3. systemic lupus erythematosus
4. HIV/AIDS
C

Which of the following diseases is not due to autoimmunity?

1. rheumatic fever
2. systemic lupus erythematosus
3. diabetes mellitus
4. HIV/AIDS

D