

Immunology Learning Objectives for Examination in Immunology

1. Overview

- a. Describe the immune defense system
- b. Understand the basic elements of innate immune mechanisms (short description of cells and molecules of innate immunity)
- c. Describe the basic elements of adaptive immune mechanisms

2. The inflammatory response

- a. Describe in general terms how the innate immune system recognizes threats
- c. Define the terms PAMPs, DAMPs and PRRs
- d. Give examples of PAMPs, DAMPs and the PRRs that recognize them
- e. List the consequences of sentinel cell exposure to PAMPs and DAMPs
- f. Understand the purposes of inflammation and its roles in immunity
- g. Describe difference in cell composition in acute and chronic inflammation
- h. Describe the blood vessel changes that occur during acute inflammation
- I. Describe the steps of extravasation and chemotaxis of leukocytes in the acute inflammatory process

3. Complement

- a. Identify the similarities and differences in the classical, lectin and alternative pathways of complement activation
- d. Describe the initiation of the classical, lectin and alternative pathways of complement activation
- e. Understand the important consequences of complement activation
- f. Describe in general terms the assembly and function of the membrane attack complex (MAC)

4. Cytokines

- a. Understand how cells of the immune system communicate
- b. Understand how cytokines regulate cellular functions
- c. Explain the role of cytokines in T helper cell differentiation into Th1, Th2, Th17 and Treg cells and describe the production of cytokines by these distinct T helper cell subsets.

5. Antigens and Antigen processing

- a. Understand the nature of antigens (keywords: Immunogen, Antigen, Hapten, Epitope, Antigenic determinant, Hapten-carrier conjugate, Adjuvant, Superantigen)
- b. Differentiate between T independent and T dependent antigens and their responses
- c. Know MHC I and MHC II processing
- d. Know on which cells MHC I and MHC II antigens are found
- e. Know the importance and function of different populations of dendritic cells
- f. Understand the difference between Th1, Th2, Th17 and Treg cells

6. MHC

- a. Know the general characteristics of MHC
- b. Distinguish between MHC I and MHC II
- c. Understand how MHC molecules bind antigens and the differences between antigens bound by class I or class II molecules
- d. Understand how APCs process and present antigens and the roles of MHC I and II molecules in this process

7. Lymphoid organs and Lymphocytes

- a. Compare the function of primary (bone marrow, thymus) and secondary lymphoid organs (lymph nodes, spleen, MALT) and describe what happens to B and T lymphocytes in these organs
- b. Know the properties of T and B lymphocytes, macrophages and dendritic cells.

8. T and B cells and their response to antigens

- a. Understand the structure of the TCR and CD3 complex
- b. Describe the nature of the 1st, 2nd and 3rd signals necessary for T cell activation
- c. Explain the actions of Tc cells on target cells
- d. Understand the role of Th cells in the immune response
- e. Describe the differences in the requirements for naïve and effector T cell activation
- f. Understand the structure of the BCR
- g. Understand the interactions between Th and B cells
- h. Describe events in the germinal center
- I. Understand the important differences between T-independent and T-dependent antigens

9. Antibodies and Antigen receptors

- a. Explain all the phases of a humoral response
- b. Understand the effector functions of antibodies
- c. Understand the structure of antibodies
- d. Explain isotype, allotype and idiotype
- e. Understand the molecular events involved in class switching and affinity maturation

10. CELL-MEDIATED IMMUNITY: Cell-cell interactions in specific immune responses

- a. Describe the cell-cell interactions which occur in (i) antibody responses to T-dependent antigens, (ii) generation of cytotoxic T cells, and (iii) activation of macrophages and NK cells
- b. Discuss the mechanisms of killing by cytotoxic T cells and NK cells
- c. Understand the roles of Tc, activated macrophages, and NK cells

11. Tolerance and Regulation

- a. Understand the concept of tolerance
- b. Describe the process and outcome of positive and negative selection of T cells in the thymus
- c. Explain the role of regulatory T cells (natural and induced) in mediating peripheral tolerance
- d. Explain the process of central and peripheral tolerance (how T and B cells become tolerant at the periphery)
- e. Understand how each step of the immune system is regulated and the role played by cytokines

12. Immunity to infection

1. Describe the molecules and cell populations that protect us against bacteria and how they do it.
2. Describe the cell populations and molecules that protect us against viruses and how they do it
3. Describe the cell populations and molecules that protect us against fungi
4. Describe strategies that bacteria and viruses use to avoid the immune system

5. Describe responses to microorganisms can result in immunological tissue damage.

13. Hypersensitivity

1. Describe the mechanism of type 1 hypersensitivity.
2. List mediators released during mast cell degranulation and synthesized after degranulation
3. Describe common methods of entry of substances into body
4. Identify different allergens that can trigger type I hypersensitivity
5. Discuss pathophysiology of allergy, anaphylaxis
6. Describe management strategies for type 1 hypersensitivity
7. Describe prevention of anaphylaxis, appropriate patient education
8. Describe the mechanism of type II hypersensitivity
9. List diseases where their pathogenesis involves type II hypersensitivity?
10. Describe the mechanism for type III hypersensitivity
11. List diseases where the pathogenesis involves type III hypersensitivity
12. Describe the mechanism of type IV hypersensitivity.
13. List diseases that involve type IV hypersensitivity

14. Autoimmune diseases

1. Describe how autoimmune diseases are classified
2. Name autoantigens in organ- specific and autoantigens in non-organ specific autoimmune diseases
3. Describe the mechanisms of pathogenesis in autoimmune diseases in relation to different types of hypersensitivity
4. Discuss the mechanisms that maintain self-tolerance and the potential mechanisms leading to its breakdown
5. Describe additional factors associated with autoimmune diseases
6. Describe the treatments of autoimmune diseases

15. Tumor Immunology

1. List the evidence that the immune system plays a role in controlling tumor
2. Describe the different kinds of tumor associated antigens
3. List the main ways in which tumors evade the immune system
4. Describe the mechanism of cross-priming as it relates to tumors
5. Describe the way in which antibodies to regulatory molecules are used in the treatment of tumors
6. Describe the preparation of a dendritic vaccine

16. Immunodeficiencies

1. Describe the consequences of inherited or acquired deficiencies in the various elements of the immune system
2. Recognize clinical signs and symptoms that would warrant a work-up for a primary immunodeficiency disorder

3. Select the laboratory work-up required to diagnose the more common immunodeficiency disorders
4. Describe the treatment options for patients with primary immunodeficiency disorders including immunoglobulin replacement
5. Define secondary immunodeficiency and list the types that occur. Describe HIV and AIDS.

17. Transplantation

1. List the diverse organs and tissues that have been transplanted and especially those that are commonly transplanted
2. Describe blood groups and why there are problems with transfusion
3. Explain why the MHC/HLA genes represent a major barrier to transplantation
4. Describe the main strategies used to prevent graft rejection
5. Describe Graft versus host reactions and why they occur
6. Explain what xeno-transplants are and describe how pig organs require to be manipulated before they can be transplanted successfully in humans