**Chapter 7.9: Physiology of immune system**

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**A. Refresher points/ Table**

* Immuno-physiology in veterinary medicine encompasses the intricate study of the immune system's structure, function, and interactions within the realm of animal health and disease.
* **Components of the Immune System:**

1. **Innate Immunity**: First line of defence against pathogens, offering immediate protection:
   * Innate Active Immunity: Natural resistance acquired from environmental exposure (e.g., skin barrier).
   * Innate Passive Immunity: Temporary immunity passed from mother to offspring (e.g., maternal antibodies in breast milk).
2. **Adaptive Immunity**: Tailored response to specific pathogens, with memory and specificity:
   * Acquired Active Immunity:Developed from exposure to antigens, leading to antibody production and memory cells (e.g., vaccination).
   * Acquired Passive Immunity: Temporary immunity from transfer of pre-formed antibodies (e.g., antivenom administration).

* **Immunoglobulins (Antibodies):**

These glycoprotein molecules are produced by B cells in response to foreign antigens, playing a vital role in humoral immunity:

|  |  |  |  |
| --- | --- | --- | --- |
| **Class** | **Structure** | **Location** | **Function** |
| IgG | Monomer | Free in placenta | Cross placenta and provide passive immunity to foetus |
| IgM | Pentamer | Surface of B cells | 1st class of Ab released during primary response |
| IgD | Monomer | Surface of B cells | B cell activation |
| IgA | Dimer | Body secretions | Protect mucosal surface |
| IgE | Monomer | On mast cell and basophils | Contribute to inflammation and allergic reactions |

* **MHC (Major Histocompatibility Complex):**

MHC molecules play a crucial role in the immune system by presenting antigens to T cells, thereby initiating immune responses. They are divided into two classes: MHC class I molecules, which present intracellular antigens to CD8+ T cells, and MHC class II molecules, which present extracellular antigens to CD4+ T cells. MHC diversity is essential for antigen presentation and immune recognition, influencing immune responses and susceptibility to diseases.

* **Complement System:**

The complement system, a group of proteins, enhances immune responses by promoting inflammation and aiding in pathogen destruction. It has three activation pathways: classical (triggered by antigen-antibody complexes), alternative (activated independently of antibodies), and lectin (initiated by lectin binding to microbial surfaces).

Its effector functions include opsonization (enhancing phagocytosis), inflammation (recruiting immune cells), membrane attack complex formation (causing cell lysis), and immune complex clearance.

* **Mechanisms of Immune Response:**
* **Tissue Macrophage System**: Tissue-resident macrophages, derived from circulating monocytes, maintain tissue health by engulfing pathogens and debris.
* **Inflammatory Response**: Triggered by pathogens or tissue damage, inflammation aims to eliminate threats and initiate repair. Features include immune cell recruitment and cytokine release, with tissue macrophages amplifying the response.
* **Phagocytic Mechanism**: Phagocytic cells recognize pathogens through pattern recognition receptors and engulf them, leading to their digestion or presentation to other immune cells.
* **Immunomodulation:** Immunomodulin is a protein that regulates immune responses by modulating the activity of immune cells. It has anti-inflammatory properties and can enhance the function of regulatory T cells, which helps maintain immune balance and prevent excessive inflammation. Immunomodulin shows promise in various therapeutic applications, including autoimmune diseases and transplantation, due to its ability to regulate immune tolerance and reduce inflammatory responses.
* **Ontogeny and Phylogeny of the Immune System:**
* **Ontogeny:** The development of an individual's immune system, from embryonic stages to adulthood, involves the maturation of immune cells in organs like the thymus and bone marrow, leading to a functional immune system capable of defending against pathogens and maintaining health.
* **Phylogeny:** Across different species, immune systems have evolved diverse mechanisms for detecting and responding to pathogens, shaped by evolutionary pressures and interactions with the environment, allowing organisms to adapt and survive in their respective ecological niches.
* **Hypersensitivity:** Hypersensitivity is an exaggerated immune response to harmless substances, resulting in tissue damage or clinical symptoms:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Type I** | **Type II** | **Type III** | **Type IV** |
| **Known as** | Immediate Hypersensitivity | Cytotoxic Hypersensitivity | Immune Complex-Mediated Hypersensitivity | Delayed-Type Hypersensitivity |
| **Immune reactant** | IgE | IgG or IgM | IgG or IgM | T cell |
| **Mechanism of activation** | IgE binds to mast cell causing histamine release | IgG or IgM bind to antigen, leading to complement activation and cell lysis | Ag-Ab complex is deposited in tissues, complement activation provide inflammatory mediators and neutrophils | Th1 cell secrete cytokines, which activates microphages and cytotoxic T cells |
| **Example** | hay fever, asthma, and anaphylaxis | autoimmune haemolytic anaemia and some drug reactions | systemic lupus erythematosus (SLE) and serum sickness | contact dermatitis and certain drug reactions |

* **Diseases related to immune system:**
* **Canine Atopic Dermatitis:** Similar to human allergies, dogs can develop atopic dermatitis, an allergic skin disease triggered by environmental allergens such as pollen, dust mites, and mold. It leads to itching, redness, and skin lesions due to an abnormal immune response.
* **Feline Immunodeficiency Virus (FIV):** FIV is a viral infection in cats that compromises the immune system, similar to HIV in humans. It weakens the cat's ability to fight off infections and can lead to various secondary infections and illnesses.
* **Equine Infectious Anaemia (EIA):** Also known as swamp fever, EIA is a viral disease affecting horses, mules, and donkeys. It attacks the immune system, causing recurrent fever, anaemia, weight loss, and weakness. EIA can be fatal and is spread primarily through blood-sucking insects.
* **Bovine Respiratory Disease (BRD):** BRD is a complex respiratory disease affecting cattle, caused by a combination of viral and bacterial pathogens. It compromises the animal's immune response, leading to pneumonia, fever, coughing, and reduced weight gain.
* **Advances in Immuno-physiology:**
* **Immunotherapy:** Breakthroughs in cancer treatment through immune checkpoint inhibitors and CAR T-cell therapy.
* **Microbiota-Immune System:** Understanding how gut bacteria influence immune responses, leading to new therapeutic approaches.
* **Vaccine Innovation:** Rapid development of mRNA and viral vector vaccines, along with research into novel adjuvants and delivery systems.
* **Single-Cell Technologies:** Providing insights into immune cell dynamics at the single-cell level.
* **Innate Immunity:** Recognition of the critical role of innate immune cells in shaping responses and potential targets for disease therapy.

**B. Fill in the blanks**

1. The primary function of the immune system is to defend the body against…………...
2. The process by which immune cells recognize and eliminate foreign substances is called………………….
3. …………………are specialized white blood cells that play a central role in the adaptive immune response.
4. The cells responsible for producing antibodies are called……………….
5. The proteins that bind to specific antigens and mark them for destruction by immune cells are called……………….
6. The major histocompatibility complex (MHC) molecules present antigens to…………… for recognition.
7. The main function of cytotoxic T cells is to kill ……………. cells.
8. The process of………………… involves the production of antibodies by B cells.
9. Helper T cells release………………… that stimulate other immune cells.
10. The molecule responsible for mediating the binding of T cells to antigen-presenting cells is called……………….
11. The production of antibodies by B cells is stimulated by …………. cells.
12. ……………… is the process by which immune cells learn to recognize self from non-self.
13. Immunoglobulins are another name for ……………...
14. ……………. are proteins secreted by cells that regulate the immune response.
15. The cells responsible for engulfing and digesting pathogens are called…………….
16. The type of immunity that is acquired through vaccination is called………. immunity.
17. The type of immunity that is passed from mother to offspring through breast milk is called ………………. immunity.
18. The first line of defence against pathogens is…………… immunity.
19. The process by which phagocytes move toward the site of infection is called…………...
20. The molecule responsible for binding to the Fc region of antibodies and promoting phagocytosis is called …………....
21. Inflammation is characterized by redness, heat, swelling, and …………. at the site of infection.
22. The cells responsible for releasing histamine during allergic reactions are called ………cells.
23. The cells responsible for destroying virus-infected cells and cancer cells are called ……………... cells.
24. Autoimmune diseases occur when the immune system mistakenly attacks…………. tissues.
25. The cells responsible for coordinating the immune response and producing cytokines are called…………… cells.
26. The main function of memory T cells is to provide………………. immunity upon re-exposure to a pathogen.
27. The cells responsible for presenting antigens to T cells in the skin are called ……………. cells.
28. The type of immune response that involves the production of antibodies is called ………………….immunity**.**
29. The type of immune response that does not involve antibodies is called ………………... immunity.
30. The process by which immune cells eliminate cancerous cells is called …………………...

**C. Multiple Choice Questions**

1. Which cells are primarily responsible for the adaptive immune response?
2. Neutrophils
3. Macrophages
4. B cells and T cells
5. Eosinophil
6. Which of the following is not a primary lymphoid organ?
7. Thymus
8. Bone marrow
9. Spleen
10. Liver
11. What is the main function of dendritic cells in the immune system?
12. Phagocytosis of pathogens
13. Production of antibodies
14. Antigen presentation to T cells
15. Activation of B cells
16. Which type of immunity is mediated by antibodies produced by B cells?
17. Cell-mediated immunity
18. Innate immunity
19. Humoral immunity
20. Adaptive immunity
21. What is the role of helper T cells in the immune response?
22. Directly kill infected cells
23. Produce antibodies
24. Activate other immune cells
25. Phagocytose pathogens
26. Which class of antibodies is involved in mucosal immunity?
27. IgA
28. IgG
29. IgE
30. IgM
31. Which cells are responsible for producing antibodies?
32. B cells
33. T cells
34. Natural killer cells
35. Macrophages
36. What is the primary function of cytotoxic T cells?
37. Secretion of cytokines
38. Phagocytosis of pathogens
39. Killing of virus-infected cells
40. Activation of B cells
41. Which cytokine is involved in promoting inflammation and attracting immune cells to the site of infection?
42. Interleukin-10
43. Interferon-gamma
44. Tumor necrosis factor-alpha
45. Transforming growth factor-beta
46. Which type of cell is responsible for presenting antigens to T cells?
47. B cells
48. Macrophages
49. Dendritic cells
50. Natural killer cells
51. What is the function of memory B cells?
52. Produce antibodies during a primary immune response
53. Phagocytose pathogens
54. Provide long-term immunity upon re-exposure to an antigen
55. Kill virus-infected cells
56. Which of the following is not a characteristic of the adaptive immune response?
57. Specificity
58. Memory
59. Rapid response to infection
60. Diversity
61. Which type of cell is responsible for antibody class switching?
62. Helper T cells
63. Memory B cells
64. Plasma cells
65. Regulatory T cells
66. Which class of antibodies can cross the placenta to provide passive immunity to the foetus?
67. IgA
68. IgG
69. IgE
70. IgM
71. What is the role of regulatory T cells in the immune system?
72. Activate other immune cells
73. Produce antibodies
74. Suppress excessive immune responses
75. Phagocytose pathogens
76. Which type of cell secretes antibodies?
77. Plasma cells
78. Helper T cells
79. Cytotoxic T cells
80. Memory B cells
81. Which type of immunity is acquired through vaccination?
82. Passive immunity
83. Active immunity
84. Innate immunity
85. Humoral immunity
86. What is the primary function of the complement system?
87. Phagocytosis of pathogens
88. Activation of B cells
89. Killing of virus-infected cells
90. Enhancement of the immune response
91. Which cells are responsible for granulomatous inflammation?
92. Macrophages
93. Neutrophils
94. Eosinophils
95. Basophils
96. Which type of cell produces histamine during allergic reactions?
    1. Neutrophils
    2. Eosinophils
    3. Mast cells
    4. Macrophages
97. Which type of cell mediates antibody-dependent cell-mediated cytotoxicity (ADCC)?
    1. Natural killer cells
    2. Helper T cells
    3. Cytotoxic T cells
    4. Memory B cells
98. Which type of immunity is provided by the transfer of antibodies from one individual to another?
    1. Passive immunity
    2. Active immunity
    3. Innate immunity
    4. Humoral immunity
99. What is the main function of Toll-like receptors (TLRs) in the immune system?
    1. Phagocytosis of pathogens
    2. Activation of the complement system
    3. Recognition of pathogen-associated molecular patterns (PAMPs)
    4. Production of antibodies
100. Which type of cell is responsible for secreting cytokines to recruit and activate immune cells?
     1. Plasma cells
     2. Mast cells
     3. Eosinophils
     4. Macrophages
101. Which class of antibodies is involved in allergic reactions?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
102. What is the role of MHC molecules in the immune response?
     1. Present antigens to T cells
     2. Produce antibodies
     3. Kill virus-infected cells
     4. Mediate phagocytosis of pathogens
103. Which cells are primarily responsible for producing antibodies during a secondary immune response?
     1. Plasma cells
     2. Memory B cells
     3. Dendritic cells
     4. Natural killer cells
104. Which type of cell is responsible for phagocytosing pathogens and presenting antigens to T cells?
     1. B cells
     2. Mast cells
     3. Macrophages
     4. Eosinophils
105. Which of the following is not a function of antibodies?
     1. Opsonization
     2. Neutralization
     3. Phagocytosis
     4. Complement activation
106. Which type of immunity is mediated by cytotoxic T cells?
     1. Passive immunity
     2. Active immunity
     3. Cell-mediated immunity
     4. Humoral immunity
107. Which cytokine is primarily produced by Th1 cells and is involved in activating macrophages?
     1. Interleukin-10
     2. Interleukin-4
     3. Interferon-gamma
     4. Tumor necrosis factor-alpha
108. Which type of cell is responsible for antibody-mediated immune responses against parasitic infections?
109. Mast cells
110. Basophils
111. Eosinophils
112. Neutrophils
113. Which type of hypersensitivity reaction involves the formation of immune complexes and subsequent tissue damage?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
114. Which class of antibodies can activate the classical pathway of the complement system?
115. IgA
116. IgG
117. IgE
118. IgM
119. What is the main function of the thymus gland in the immune system?
     1. Production of antibodies
     2. Maturation of T cells
     3. Phagocytosis of pathogens
     4. Activation of B cells
120. Which type of cell is responsible for maintaining self-tolerance and preventing autoimmune reactions?
     1. Regulatory T cells
     2. Helper T cells
     3. Cytotoxic T cells
     4. Memory T cells
121. Which molecule is expressed on the surface of cytotoxic T cells and is involved in recognizing antigen-presenting cells?
     1. CD4
     2. CD8
     3. CD19
     4. CD20
122. Which type of cell is responsible for producing cytokines that promote inflammation and recruit immune cells to the site of infection?
     1. Natural killer cells
     2. Helper T cells
     3. Plasma cells
     4. Regulatory T cells
123. Which cell-surface molecule is required for T cell activation and is known as the co-receptor for the T cell receptor?
     1. MHC class I
     2. MHC class II
     3. CD4
     4. CD10
124. Which type of immunity is primarily mediated by T cells and does not involve antibodies?
     1. Passive immunity
     2. Active immunity
     3. Cell-mediated immunity
     4. Humoral immunity
125. Which type of cell is responsible for secreting antibodies into the bloodstream?
     1. Plasma cells
     2. Memory B cells
     3. Dendritic cells
     4. Natural killer cells
126. Which type of cell expresses high levels of CD14 and Toll-like receptors and is involved in recognizing and phagocytosing bacteria?
     1. Macrophages
     2. Neutrophils
     3. Mast cells
     4. Eosinophils
127. Which type of cell is responsible for presenting exogenous antigens to helper T cells?
     1. T cells
     2. Dendritic cells
     3. B cells
     4. Neutrophils
128. Which class of antibodies is the first to be produced during an immune response?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
129. Which type of immunity is provided by memory T cells?
     1. Passive immunity
     2. Active immunity
     3. Innate immunity
     4. Cell-mediated immunity
130. Which type of cell is responsible for producing antibodies with high affinity and specificity during the secondary immune response?
     1. Memory B cells
     2. Plasma cells
     3. Dendritic cells
     4. Natural killer cells
131. Which type of hypersensitivity reaction is mediated by IgE antibodies and mast cells?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
132. Which type of cell is responsible for producing antibodies with different effector functions, such as IgG, IgA, and IgE?
     1. Memory B cells
     2. Plasma cells
     3. Dendritic cells
     4. Natural killer cells
133. Which type of cell expresses high levels of Fc receptors and is involved in antibody-dependent cellular cytotoxicity (ADCC)?
     1. Macrophages
     2. Neutrophils
     3. Natural killer cells
     4. Eosinophils
134. Which cytokine is primarily produced by Th2 cells and is involved in promoting the production of IgE antibodies?
     1. Interleukin-2
     2. Interleukin-4
     3. Interferon-gamma
     4. Tumor necrosis factor-alpha
135. Which type of cell is responsible for suppressing immune responses and maintaining peripheral tolerance?
     1. Regulatory T cells
     2. Helper T cells
     3. Cytotoxic T cells
     4. Memory T cells
136. Which type of cell is primarily responsible for producing antibodies against viral infections?
     1. Plasma cells
     2. Memory B cells
     3. Dendritic cells
     4. Natural killer cells
137. Which type of hypersensitivity reaction involves the activation of complement and the formation of membrane attack complexes?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
138. Which class of antibodies is primarily found in secretions such as tears, saliva, and breast milk?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
139. Which type of cell expresses high levels of Toll-like receptors and is involved in innate immune responses to bacterial infections?
     1. Macrophages
     2. Neutrophils
     3. Mast cells
     4. Eosinophils
140. Which class of antibodies is the first to be produced during foetal development?
     1. IgM
     2. IgG
     3. IgE
     4. IgA
141. Which cytokine is primarily produced by Th17 cells and is involved in promoting inflammation and neutrophil recruitment?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-17
     4. Interferon-gamma
142. Which type of hypersensitivity reaction involves the formation of granulomas and is associated with delayed-type hypersensitivity?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
143. Which molecule is involved in the activation of complement by the classical pathway?
     1. Mannose-binding lectin
     2. C1q
     3. Factor B
     4. Properdin
144. Which class of antibodies is primarily involved in protecting mucosal surfaces?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
145. Which cytokine is primarily produced by regulatory T cells and is involved in suppressing immune responses?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-10
     4. Transforming growth factor-alpha (TGF-α)
146. Which type of hypersensitivity reaction is mediated by cytotoxic T cells and involves tissue destruction?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
147. Which molecule is involved in the recognition of pathogen-associated molecular patterns (PAMPs) by immune cells?
     1. Toll-like receptors (TLRs)
     2. Major histocompatibility complex (MHC)
     3. CD4
     4. CD8
148. Which type of cell is primarily responsible for killing virus-infected cells?
     1. Plasma cells
     2. Memory B cells
     3. Cytotoxic T cells
     4. Natural killer cells
149. Which class of antibodies is involved in activating eosinophils and mediating allergic reactions?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
150. Which cytokine is primarily produced by mast cells and is involved in promoting inflammation and smooth muscle contraction?
     1. Interleukin-2
     2. Interleukin-4
     3. Histamine
     4. Interferon-gamma
151. Which molecule is involved in the activation of complement by the alternative pathway?
     1. Mannose-binding lectin
     2. C1q
     3. Factor B
     4. Properdin
152. Which class of antibodies is the first to be produced during an infant's immune response to infection?
     1. IgM
     2. IgG
     3. IgE
     4. IgA
153. Which cytokine is primarily produced by Th2 cells and is involved in promoting B cell proliferation and class switching to IgE?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-17
     4. Interferon-gamma
154. Which type of hypersensitivity reaction involves the release of preformed mediators such as histamine from mast cells and basophils?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
155. Which molecule is involved in the recognition of self-antigens by autoreactive T cells in the thymus?
     1. Toll-like receptors (TLRs)
     2. Major histocompatibility complex (MHC)
     3. CD4
     4. CD8
156. Which class of antibodies is primarily involved in neutralizing toxins produced by bacteria?
     1. IgA
     2. IgG
     3. IgM
     4. IgE
157. Which cytokine is primarily produced by Th1 cells and is involved in activating cytotoxic T cells?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-10
     4. Interferon-gamma
158. Which type of hypersensitivity reaction involves the formation of granulomas and is associated with tuberculosis?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
159. Which molecule is involved in the recognition of viral peptides presented by infected cells to cytotoxic T cells?
     1. Toll-like receptors (TLRs)
     2. Major histocompatibility complex (MHC)
     3. T cell receptor (TCR)
     4. CD8
160. Which type of cell is primarily responsible for producing antibodies against viruses in the respiratory tract?
     1. Plasma cells
     2. IgA-producing plasma cells
     3. Dendritic cells
     4. Natural killer cells
161. Which class of antibodies is primarily involved in allergic reactions, asthma, and anaphylaxis?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
162. Which cytokine is primarily produced by regulatory T cells and is involved in suppressing immune responses?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-10
     4. Interferon-gamma
163. Which type of hypersensitivity reaction involves the formation of immune complexes in the glomeruli of the kidneys?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
164. Which molecule is involved in the activation of complement by the lectin pathway?
     1. Mannose-binding lectin (MBL)
     2. C1q
     3. Factor B
     4. Properdin
165. Which type of cell is primarily responsible for presenting lipid antigens to T cells?
     1. Macrophages
     2. Dendritic cells
     3. B cells
     4. Natural killer cells
166. Which cytokine is primarily produced by Th17 cells and is involved in promoting neutrophil chemotaxis?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-17
     4. Interferon-gamma
167. Which type of hypersensitivity reaction is mediated by immune complexes deposited in blood vessel walls?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
168. Which molecule is involved in the recognition of lipopolysaccharide (LPS) from Gram-negative bacteria?
     1. Toll-like receptor 4 (TLR4)
     2. Major histocompatibility complex (MHC)
     3. CD4
     4. CD14
169. Which class of antibodies is primarily involved in crossing the placenta to provide passive immunity to the foetus?
     1. IgG
     2. IgM
     3. IgE
     4. IgA
170. Which cytokine is primarily produced by Th1 cells and is involved in activating macrophages?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-10
     4. Interferon-gamma
171. Which type of hypersensitivity reaction involves T cell-mediated destruction of host tissues?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
172. Which molecule is involved in the recognition of antigenic peptides presented by MHC class II molecules?
     1. Toll-like receptors (TLRs)
     2. Major histocompatibility complex (MHC)
     3. T cell receptor (TCR)
     4. CD8
173. Which type of cell is primarily responsible for producing antibodies against pathogens in the respiratory tract?
     1. IgA-producing plasma cells
     2. Memory B cells
     3. Dendritic cells
     4. Natural killer cells
174. Which class of antibodies is primarily involved in mediating allergic reactions, such as hay fever and eczema?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
175. Which cytokine is primarily produced by regulatory T cells and is involved in suppressing immune responses?
176. Interleukin-2
177. Interleukin-4
178. Interleukin-10
179. Interferon-gamma
180. Which type of hypersensitivity reaction involves the formation of immune complexes in the basement membrane of epithelial tissues?
181. Type I
182. Type II
183. Type III
184. Type IV
185. Which molecule is involved in the activation of complement by the lectin pathway?
186. Mannose-binding lectin (MBL)
187. C1q
188. Factor B
189. Properdin
190. Which type of cell is primarily responsible for presenting antigens to CD8+ T cells?
191. Macrophages
192. Dendritic cells
193. B cells
194. Natural killer cells
195. Which class of antibodies is the most abundant in mucosal secretions such as saliva and tears?
196. IgA
197. IgG
198. IgE
199. IgM
200. Which cytokine is primarily produced by Th2 cells and is involved in promoting the growth and differentiation of eosinophils?
201. Interleukin-2
202. Interleukin-5
203. Interleukin-17
204. Interferon-gamma
205. Which type of hypersensitivity reaction involves the activation of complement by antibodies bound to the surface of host cells?
206. Type I
207. Type II
208. Type III
209. Type IV
210. Which molecule is involved in the recognition of double-stranded RNA (dsRNA) from viruses?
211. Toll-like receptor 3 (TLR3)
212. Major histocompatibility complex (MHC)
213. CD4
214. CD14
215. Which class of antibodies is involved in defending against bacterial infections by promoting opsonization and phagocytosis?
     1. IgA
     2. IgG
     3. IgM
     4. IgE
216. Which cytokine is primarily produced by Th1 cells and is involved in activating natural killer (NK) cells?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-10
     4. Interferon-gamma
217. Which type of hypersensitivity reaction involves the formation of granulomas and is associated with chronic infections such as tuberculosis?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
218. Which molecule is involved in the recognition of viral peptides presented by MHC class I molecules?
     1. Toll-like receptors (TLRs)
     2. Major histocompatibility complex (MHC)
     3. T cell receptor (TCR)
     4. CD8
219. Which type of cell is primarily responsible for producing antibodies against pathogens in the gastrointestinal tract?
     1. IgA-producing plasma cells
     2. Memory B cells
     3. Dendritic cells
     4. Natural killer cells
220. Which class of antibodies is primarily involved in triggering immediate hypersensitivity reactions, such as anaphylaxis?
     1. IgA
     2. IgG
     3. IgE
     4. IgM
221. Which cytokine is primarily produced by regulatory T cells and is involved in suppressing immune responses?
     1. Interleukin-2
     2. Interleukin-4
     3. Interleukin-10
     4. Interferon-gamma
222. Which type of cell is primarily responsible for presenting antigens to T cells in the skin and mucosal tissues?
     1. Macrophages
     2. Langerhans cells
     3. B cells
     4. Natural killer cells
223. Which cytokine is primarily produced by Th2 cells and is involved in promoting the activation and differentiation of eosinophils?
     1. Interleukin-2
     2. Interleukin-5
     3. Interleukin-17
     4. Interferon-gamma
224. Which type of hypersensitivity reaction involves the activation of complement by IgM or IgG antibodies bound to cell surfaces?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
225. Which molecule is involved in the recognition of single-stranded RNA (ssRNA) from viruses?
     1. Toll-like receptor 7 (TLR7)
     2. Major histocompatibility complex (MHC)
     3. CD4
     4. CD14
226. Which class of antibodies is primarily involved in neutralizing bacterial toxins and preventing their binding to host cells?
     1. IgA
     2. IgG
     3. IgM
     4. IgE
227. Which type of hypersensitivity reaction involves T cell-mediated destruction of pancreatic beta cells, leading to insulin deficiency?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
228. Which class of antibodies is primarily involved in defending against parasitic infections by activating eosinophils and mast cells?
229. IgA
230. IgG
231. IgE
232. IgM
233. Which molecule is involved in the activation of complement by the lectin pathway?
     1. Mannose-binding lectin (MBL)
     2. C1q
     3. Factor B
     4. Properdin
234. Which type of cell is primarily responsible for presenting antigens to T cells in the lymph nodes?
     1. Macrophages
     2. Dendritic cells
     3. B cells
     4. Natural killer cells
235. Which cytokine is primarily produced by Th2 cells and is involved in promoting the proliferation and differentiation of B cells?
236. Interleukin-2
237. Interleukin-4
238. Interleukin-17
239. Interferon-gamma
240. Which molecule is involved in the recognition of flagellin from bacteria?
     1. Toll-like receptor 5 (TLR5)
     2. Major histocompatibility complex (MHC)
     3. CD4
     4. CD14
241. Which type of hypersensitivity reaction involves T cell-mediated destruction of insulin-producing beta cells in the pancreas?
     1. Type I
     2. Type II
     3. Type III
     4. Type IV
242. Which molecule is involved in the recognition of lipopeptides from bacteria?
     1. Toll-like receptors (TLRs)
     2. CD14
     3. T cell receptor (TCR)
     4. CD8
243. Which type of cell is primarily responsible for secreting cytokines that regulate the immune response and coordinate the activities of other immune cells?
     1. Plasma cells
     2. T helper cells
     3. Natural killer cells
     4. Eosinophils
244. Which of the following techniques has revolutionized our understanding of immune cell interactions and signalling pathways?
     1. Electron microscopy
     2. X-ray crystallography
     3. Single-cell analysis
     4. Immunohistochemistry
245. Advances in immune-physiology have primarily focused on:
     1. Understanding the role of physical barriers in immunity
     2. Unravelling the molecular mechanisms of phagocytosis
     3. Investigating the function of TLR receptors
     4. Exploring previously unknown aspects of immune function
246. The ontogeny of the immune system refers to its:
     1. Evolutionary history
     2. Development during embryonic stages
     3. Response to external stimuli
     4. Interaction with other physiological systems
247. Which of the following is true regarding the phylogeny of the immune system?
     1. It remains unchanged across different species
     2. It primarily involves the study of human immune development
     3. It refers to the evolutionary origins and diversification of immune mechanisms
     4. It is solely influenced by genetic factors
248. Recent advancements in immunology have led to:
     1. A decrease in the complexity of immune responses
     2. A limited understanding of immune cell interactions
     3. Improved therapies for autoimmune disorders
     4. New insights into immune cell function and regulation
249. Which imaging technique allows visualization of immune cell interactions in real-time?
     1. Magnetic resonance imaging (MRI)
     2. Positron emission tomography (PET)
     3. Fluorescence microscopy
     4. Confocal microscopy
250. Ontogeny of the immune system involves the study of its development:
     1. Across different phylogenetic groups
     2. During embryonic stages and throughout life
     3. Only in adult organisms
     4. Exclusively in vertebrates
251. Phylogeny of the immune system encompasses:
     1. The study of immune response patterns in individual organisms
     2. Comparisons of immune systems across species and evolutionary history
     3. The interaction between the immune system and other bodily systems
     4. The influence of genetics on immune function
252. Single-cell analysis techniques allow researchers to:
     1. Study the entire immune system in a single experiment
     2. Investigate interactions between immune cells and pathogens
     3. Analyse the heterogeneity of immune cell populations
     4. Identify specific immune cell types using imaging
253. The ontogeny of the immune system involves:
     1. The study of immune responses in different tissues
     2. The development of immunity from birth to old age
     3. The comparison of immune systems between species
     4. The role of genetics in immune function
254. What aspect of the immune system does ontogeny primarily focus on?
     1. Immune cell interactions
     2. Immune responses to pathogens
     3. Immune development during embryonic stages and throughout life
     4. Immune regulation
255. Which of the following best describes phylogeny in the context of the immune system?
     1. The study of immune responses within an individual organism
     2. The examination of immune system development in vertebrates
     3. Comparisons of immune systems across species and evolutionary history
     4. The influence of environmental factors on immune function
256. Advances in immune-physiology have contributed to:
     1. A decrease in the complexity of immune responses
     2. A better understanding of immune cell interactions and signalling pathways
     3. The elimination of autoimmune disorders
     4. The restriction of immune responses to specific pathogens
257. Which of the following techniques has enabled researchers to study immune cell behaviour at a single-cell level?
     1. Flow cytometry
     2. Single-cell RNA sequencing
     3. Western blotting
     4. Immunohistochemistry
258. The study of ontogeny and phylogeny of the immune system is essential for understanding:
     1. Immune responses in adult organisms
     2. Immune cell interactions in tissue microenvironments
     3. The development and evolutionary origins of immune mechanisms
     4. Immune modulation by external factors
259. Recent advancements in immunology have led to:
     1. A decline in the complexity of immune responses
     2. A narrow focus on innate immunity
     3. A deeper understanding of immune cell interactions and signalling pathways
     4. An increase in autoimmune disorders
260. Single-cell analysis techniques have allowed researchers to:
     1. Study immune cell interactions in vivo
     2. Characterize the heterogeneity of immune cell populations
     3. Investigate immune responses in multicellular organisms
     4. Visualize immune cells using electron microscopy
261. Ontogeny of the immune system refers to its:
262. Phylogenetic origins
263. Development during embryonic stages and throughout life
264. Response to environmental stimuli
265. Interactions with other physiological systems
266. Phylogeny of the immune system involves:
267. The study of immune responses in individual organisms
268. Comparisons of immune systems across species and evolutionary history
269. The development of immunity from birth to old age
270. The regulation of immune responses by genetic factors
271. Autoimmune disorders result from:
     1. Overactive immune responses against foreign pathogens
     2. Underactive immune responses leading to immunodeficiency
     3. Immune system dysfunction where the body attacks its tissues
     4. Excessive immune cell proliferation
272. Which of the following is a common autoimmune disorder affecting livestock species?
     1. Feline leukaemia
     2. Canine distemper
     3. Equine infectious anaemia
     4. Bovine autoimmune encephalitis
273. Immunodeficiency in livestock species can result from:
     1. Overactive immune responses leading to tissue damage
     2. Genetic mutations affecting immune cell function
     3. Exposure to environmental toxins
     4. Improper diet and nutrition
274. Which of the following diseases is caused by an autoimmune response in livestock species?
     1. Brucellosis
     2. Johne's disease
     3. Autoimmune haemolytic anaemia
     4. Bovine viral diarrhoea
275. Immunodeficiency disorders in livestock can lead to:
     1. Excessive immune responses against pathogens
     2. Increased resistance to infections
     3. Greater susceptibility to diseases
     4. Enhanced immune surveillance
276. Which of the following is an example of an immunodeficiency disorder in livestock species?
     1. Bovine respiratory disease
     2. Porcine reproductive and respiratory syndrome
     3. Bovine leukosis
     4. Severe combined immunodeficiency (SCID) in Arabian horses

**D. Match the following.**

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Natural active | p. Induced by vaccination |
| b. Artificial passive | q. From mother to foetus through placenta |
| c. Artificial active | r. Injection of antiserum to travellers |
| d. Natural passive | s. Fighting infections naturally |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
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1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Oviparous animals | p. Development of immunity after recovering from an illness |
| b. Endemic diseases | q. Transfer of antibodies through breast milk |
| c. Acquired immunity | r. Diseases constantly present in a particular region or population |
| d. Active immunity | s. Fighting infection naturally |
| e. Passive immunity | t. Immunity acquired through vaccination |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Epidemic diseases | p. Administration of antibodies to provide immediate protection |
| b. Zoonotic diseases | q. Outbreak of a disease affecting a large number of people within a short period |
| c. Hyperimmune serum | r. Diseases transmitted from animals to humans |
| d. Herd immunity | s. Collective immunity in a population due to a large portion being immune |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Carrier state | p. Immune response stimulated by exposure to an antigen |
| b. Autoimmune diseases | q. Individuals capable of transmitting a pathogen without showing symptoms |
| c. Active immunity | r. Immune system attacks the body's own cells |
| d. Immunocompromised | s. Condition where the immune system is weakened or suppressed |
| e. Immunization | t. Introduction of a vaccine to induce immunity |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Pandemic diseases | p. Rapid test detecting the presence of antibodies in blood |
| b. Antiserum | q. Global outbreak of a disease affecting multiple countries or continents |
| c. Seropositive | r. Blood serum containing specific antibodies |
| d. Serological test | s. Individuals tested positive for antibodies in their blood |
| e. Seroprevalence | t. Percentage of a population with a specific antibody |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Vector-borne diseases | p. Infection transmission through insect or animal carriers |
| b. Endemic diseases | q. Diseases consistently present in a particular geographical area |
| c. Reservoir host | r. Organism harbouring a pathogen capable of infecting others |
| d. Emerging diseases | s. Newly identified or re-emerging diseases with increasing incidence |
| e. Enzootic diseases | t. Diseases affecting animals within a specific area or population |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Immunodeficiency | p. Rare diseases caused by genetic mutations affecting the immune system |
| b. Primary immunodeficiency | q. Weakened immune response due to malnutrition or certain medications |
| c. Secondary immunodeficiency | r. Inherited disorders impairing the immune system's function |
| d. Opportunistic infections | s. Diseases occurring in individuals with compromised immune systems |
| e. Inherited immunodeficiency | t. Infections caused by pathogens taking advantage of weakened immunity |

1. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| 1. Active immunization | p. Immunity resulting from the presence of antibodies in a person's body |
| 1. Passive immunization | q. Vaccination stimulating the immune system to produce antibodies |
| 1. Antibody-mediated immunity | r. Transfer of preformed antibodies to provide immediate protection |
| 1. Natural immunity | s. Immune response triggered by the presence of antibodies in the body |
| 1. Artificial immunity | t. Immunity acquired through exposure to a pathogen or antigen |

10. Match the column and choose the correct combination

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| a. Autoimmune disease | p. Hypersensitivity reaction triggered by exposure to certain substances or allergens |
| b. Immunodeficiency | q. Administration of antigens to stimulate an immune response and provide protection against specific diseases |
| c. Allergic reaction | r. Condition where the immune system is impaired, resulting in increased susceptibility to infections |
| d. Vaccination | s. Condition where the immune system mistakenly attacks the body's own cells or tissues |

**Answers**

**B. Fill in the blanks**

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | pathogens | 16 | active |
| 2 | immunosurveillance | 17 | passive |
| 3 | Lymphocytes | 18 | innate |
| 4 | plasma cells | 19 | chemotaxis |
| 5 | antibodies | 20 | Fc receptors |
| 6 | T cells | 21 | pain |
| 7 | infected or cancerous | 22 | mast |
| 8 | antibody production | 23 | cytotoxic T |
| 9 | cytokines | 24 | self |
| 10 | CD4 | 25 | helper T |
| 11 | helper T | 26 | long-lasting |
| 12 | Tolerance | 27 | Langerhans |
| 13 | antibodies | 28 | humoral |
| 14 | Cytokines | 29 | cell-mediated |
| 15 | phagocytes | 30 | immunosurveillance |

**C. MCQs**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. c | 2.d | 3.c | 4.c | 5.c | 6.a | 7.b | 8.c | 9.c | 10.c |
| 11.c | 12.c | 13.c | 14.b | 15.c | 16.a | 17.b | 18.d | 19.a | 20.c |
| 21.a | 22.a | 23.c | 24.d | 25.c | 26.a | 27.a | 28.c | 29.c | 30.c |
| 31.c | 32.c | 33.c | 34.b | 35.b | 36.a | 37.b | 38.b | 39.c | 40.c |
| 41.a | 42.a | 43.b | 44.d | 45.d | 46.b | 47.a | 48.b | 49.c | 50.b |
| 51.a | 52.a | 53.b | 54.a | 55.a | 56.a | 57.c | 58.d | 59.b | 60.a |
| 61.c | 62.d | 63.a | 64.c | 65.c | 66.c | 67.c | 68.a | 69.b | 70.a |
| 71.a | 72.c | 73.d | 74.d | 75.c | 76.b | 77.c | 78.c | 79.c | 80.a |
| 81.b | 82.c | 83.c | 84.c | 85.a | 86.d | 87.d | 88.c | 89.a | 90.c |
| 91.c | 92.c | 93.a | 94.b | 95.a | 96.b | 97.b | 98.a | 99.c | 100.d |
| 101.d | 102.c | 103.a | 104.c | 105.c | 106.b | 107.b | 108.b | 109.a | 110.c |
| 111.d | 112.c | 113.a | 114.b | 115.b | 116.a | 117.d | 118.b | 119.b | 120.c |
| 121.d | 122.b | 123.c | 124.d | 125.c | 126.b | 127.b | 128.c | 129.b | 130.c |
| 131.c | 132.b | 133.b | 134.c | 135.a | 136.b | 137.b | 138.b | 139.c | 140.d |
| 141.b | 142.c | 143.c | 144.d |

**D. Match the following.**

|  |  |
| --- | --- |
| 1 | a-s, b-r, c-p, d-q |
| 2 | a-s, b-r, c-p, d-q |
| 3 | a-s, b-r, c-p, d-t, e-q |
| 4 | a-q, b-r, c-p, d-s |
| 5 | a-q, b-r, c-p, d-s, e-t |
| 6 | a-q, b-r, c-s, d-p, e-t |
| 7 | a-p, b-q, c-r, d-s, e-t |
| 8 | a-q, b-r, c-s, d-t, e-p |
| 9 | a-q, b-r, c-p, d-s, e-t |
| 10 | a-s, b-r, c-p, d-q |

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