OCR (B) Biology A-level

3.2.2 - Immune system

Flashcards

Outline the primary defences against pathogens in animals.

Outline the primary defences against pathogens in animals.

- Lysozymes in tears hydrolyse bacterial cell walls.
- Hydrochloric acid in the stomach kills bacteria.
- Mucous membranes trap pathogens & may secrete antimicrobial enzymes. Irritation of mucous membranes in nostrils causes sneezing.
- Irritation of ciliated epithelium in respiratory tract causes coughing.

Name 3 ways the nonspecific immune system responds to infection.

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- Inflammation
- Phagocytosis
- Production of interferon (antiviral agent)

Outline the process of inflammation.

Outline the process of inflammation.

1. Damaged blood vessels release histamines, causing vasodilation.
2. Blood flow & permeability of blood vessels increase.
3. White blood cells & plasma move into the infected tissue.

Name the 2 types of white blood cell involved in phagocytosis.

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Neutrophils

Macrophages (can become antigen-presenting cells)

How does phagocytosis destroy pathogens?

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1. Phagocyte moves towards pathogen which may have been marked by opsonins via **chemotaxis**.
2. Phagocyte engulfs pathogen via endocytosis to form a **phagosome**.
3. Phagosome fuses with lysosome (**phagolysosome**).
4. Lysozymes **digest pathogen**.
5. Phagocyte absorbs the products from pathogen hydrolysis.

Explain the role of antigen-presenting cells (APCs).

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Macrophage displays antigen from pathogen on its surface (after hydrolysis in phagocytosis).

Enhance recognition by T_H cells, which cannot directly interfere with pathogens/ antigens in body fluid.

Secrete cytokines that are involved in stimulating the specific immune response.

Describe the structure and function of B and T lymphocytes.

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Many specific receptors & immunoglobulins on surface.

B cells differentiate into plasma cells to secrete antibodies.

3 types of T cell: **T helper** (secrete cytokines), **T killer** (secrete perforin), **T regulator** (suppress other immune cells to prevent autoimmune disease).

Name the 2 types of specific immune response.

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- cell-mediated
- humoral

Outline the process of the cell-mediated response.

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1. **Complementary** T_H lymphocytes bind to foreign antigen on APC.
2. Cell signalling via secretion of interleukins stimulates:

a. clonal expansion of complementary T_H cells (rapid mitosis): become **memory cells** or trigger **humoral response**

b. clonal expansion of **cytotoxic T cells** (T_C): secrete enzyme **perforin** to destroy infected cells

Outline the process of the humoral response.

Outline the process of the humoral response.

1. **Complementary** T_H lymphocytes bind to foreign antigens on antigen-presenting T cells.
2. Release cytokines that stimulate clonal expansion (rapid mitosis) of **complementary B lymphocytes**.
3. B cells differentiate into **plasma cells**.
4. Plasma cells secrete **antibodies** with complementary variable region to antigen.

What are memory cells?

What are memory cells?

Specialised T_H/ B cells produced from primary immune response

Remain in low levels in the blood

Can divide very rapidly by mitosis if the organism encounters the same pathogen again

Contrast the primary and secondary immune response.

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Secondary response:

- Faster rate of antibody production
- Shorter lag time between exposure & antibody production
- Higher concentration of antibodies
- Antibody level remains higher after the secondary response
- Pathogen usually destroyed before any symptoms appear

What is an antibody? Describe its structure.

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Proteins secreted by plasma cells.

Quaternary structure: 2 '**light chains**' held by disulfide bridges, 2 longer '**heavy chains**'.

Binding sites on **variable region** of light chains have specific tertiary structure **complementary to an antigen**.

The rest of the molecule is known as the **constant region**.

How do antibodies lead to the destruction of a pathogen?

How do antibodies lead to the destruction of a pathogen?

- Agglutinins form antigen-antibody complexes to enhance phagocytosis
- Activation of complement
- Opsonins mark microbes for phagocytes
- Antitoxins make toxins insoluble via precipitation/ neutralisation

Outline a test for antigens (e.g. from TB or HIV).

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Direct ELISA test

1. Monoclonal antibodies bind to bottom of test plate.
2. Antigen molecules in sample bind to antibody. Rinse excess.
3. Mobile antibody with ‘reporter enzyme’ attached binds to antigens that are ‘fixed’ on the monoclonal antibodies. Rinse excess.
4. Add substrate for reporter enzyme. Positive result: colour change.

Outline a test for antibodies in body fluid.

Outline a test for antibodies in body fluid.

Indirect ELISA test

1. Antigens bind to bottom of test plate.
2. Antibodies in sample bind to antigen. Rinse excess.
3. Secondary antibody with ‘reporter enzyme’ attached binds to primary antibodies from the sample.
4. Add substrate for reporter enzyme. Positive result: colour change.

Outline the Mantoux test for tuberculosis.

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PPD tuberculin is injected into forearm. Individuals with latent TB are sensitive to PPD tuberculin. A hard red bump forms on the skin. Size of the bump measured.

Compare and contrast passive and active immunity.

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Passive	Active
both involve antibodies & can be natural or artificial	
no memory cells & antibodies not replaced when broken down = short-term	memory cells produced = long-term
immediate	time lag
antibodies from external source	lymphocytes produce antibodies
no direct contact with antigen necessary	needs direct contact with antigen

Give examples of passive and active immunity.

Give examples of passive and active immunity.

passive natural: antibodies in breast milk/ across placenta

passive artificial: anti-venom, needle stick injections

active natural: humoral response to infection

active artificial: vaccination

What causes hay fever?

What causes hay fever?

Hypersensitivity of immune system to pollen allergen

1. Allergen triggers production of a specific form of Immunoglobulin E (IgE).
2. IgE attaches to mast cells, so individuals become sensitized. As more allergens are inhaled, they attach to IgE on mast cells.
3. Degranulation occurs; mast cells release histamine as part of the nonspecific immune response to remove the pathogen.
4. Causes rhinitis and itchy, watery eyes.