CAIE Biology A-level

Topic 11: Immunity

Flashcards

Define the term phagocyte.

Define the term phagocyte.

Specialised white blood cells that engulf and destroy pathogens. There are **two** types: **neutrophils** and **macrophages**.

State where phagocytes are produced.

State where phagocytes are produced.

Bone marrow

Define the term phagocytosis.

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The process by which phagocytes engulf and destroy pathogens.

Outline the process of phagocytosis.

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1. Phagocyte moves towards pathogen via chemotaxis
2. Phagocyte engulfs pathogen via endocytosis to form a phagosome
3. Phagosome fuses with lysosome forming a phagolysosome
4. Lysozymes digest pathogen
5. Products of pathogen hydrolysis absorbed by the phagocyte or released into the cytoplasm

Define the term immune response.

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The body's response to 'non-self' antigens. It consists of a non-specific phase involving neutrophils and macrophages, and a specific phase involving T and B lymphocytes.

What is an antigen?

What is an antigen?

A chemical present on the surface of a cell that induces an immune response.

What are antigen presenting cells (APCs)?

What are antigen presenting cells (APCs)?

Any type of immune cell which displays parts of a pathogen (antigens) on its surface to elicit an immune response.

What is meant by the term self antigen?

What is meant by the term self-antigen?

Antigens present on an organism's cells that are tolerated by their own immune system. They induce antibody formation in other organisms.

What is meant by the term non-self antigen?

What is meant by the term non-self antigen?

Foreign antigens that originate from outside the body and induce an immune response.

Describe the structure and function of T lymphocytes.

Describe the structure and function of T lymphocytes.

- Mature in the thymus gland
- Many specific receptors and immunoglobulins on surface
- Four main types of T lymphocyte:
  - **T helper** - bind to antigens on antigen-presenting cells and secrete interleukins
  - **T killer** - secrete perforin, destroying pathogens with a specific antigen
  - **T memory** - provide immunological memory
  - **T regulatory** - suppress other immune cells to prevent autoimmune disease

Describe the structure and function of B lymphocytes.

Describe the structure and function of B lymphocytes.

- Mature in the bone marrow
- Many specific receptors and immunoglobulins on surface
- Three main types of B lymphocyte:
  - **Plasma cells** - produces antibodies specific to a particular pathogen
  - **B effector** - divides to form plasma cells
  - **B memory** - provide immunological memory

Define the **humoral** immune response.

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Immunity regulated specifically by the production of antibodies. Associated with B lymphocytes.

State the role of plasma cells.

State the role of plasma cells.

Production of antibodies specific to a particular pathogen.

Outline the process of the cell-mediated response.

Outline the process of the cell-mediated response.

Complementary T helper lymphocytes bind to foreign antigens on **antigen-presenting cell**. T cells undergo clonal expansion.
Four main types of T lymphocytes produced:

- T effector cells
- T killer
- T helper cells
- T memory cells

Outline the process of the humoral response.

Outline the process of the humoral response.

1. **Complementary** T helper lymphocytes bind to foreign antigens on antigen-presenting T cells
2. Cytokines released that stimulate the clonal expansion of **complementary B lymphocytes**
3. B lymphocytes differentiate into **plasma cells**
4. Plasma cells secrete **antibodies** with complementary variable region to antigen. Antibodies destroy the pathogen

State the potential impact of Leukemia on blood cell count and its consequence.

State the potential impact of Leukemia on blood cell count and its consequence.

May cause uncontrolled division of bone marrow stem cells, increasing the number of red and white blood cells in the bloodstream. Leukaemia cells are typically immature and can disrupt the blood clotting cascade and specific immune responses.

State the effect of bacterial infection on T lymphocyte count.

State the effect of bacterial infection on T lymphocyte count.

T lymphocyte count increases due to the cell-mediated immune response.

A greater number of T cells will circulate the body even after the infection has subsided.

State the effect of HIV on T cell count.

State the effect of HIV on T cell count.

HIV destroys specific T cells. A decrease in normal levels of T cells is expected over time in individuals with HIV.

Compare the primary and secondary immune responses.

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- **Primary immune response** - initial response when a pathogen is first encountered. A small number of antibodies are produced slowly.

- **Secondary immune response** - pathogen encountered for a second (third, fourth…etc.) time. Immunological memory gives a rapid production of a large number of antibodies.

What is the function of memory cells?

What is the function of memory cells?

They remain in the body for a long time following an infection and provide long-term immunity. If the organism encounters the same pathogen in the future, they can divide rapidly to provide an effective secondary immune response.

Define the term autoimmune disease.

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A condition in which the immune system fails to distinguish between self and non-self antigens, so attacks and destroys healthy body tissue. Examples include arthritis and lupus.

How does autoimmune disease occur?

How does autoimmune disease occur?

T cells with self antigens are not destroyed during the maturation process. If these cells become active they will launch an immune response on self cells, leading to cell damage.

What is myasthenia gravis?

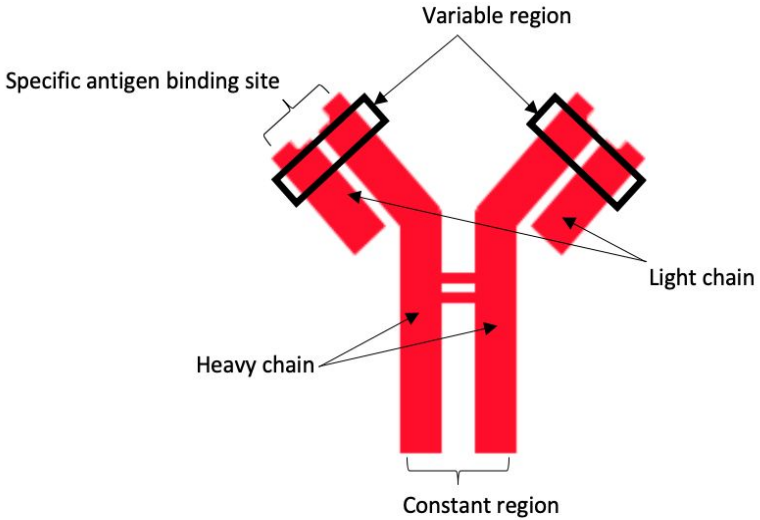
What is myasthenia gravis?

An autoimmune disease that causes skeletal muscle weakness due to the production of antibodies which damage nicotinic acetylcholine receptors at the neuromuscular junction. Motor neurons cannot be stimulated therefore muscles receive no impulses. This leads to atrophy of muscles.

Describe the structure of an antibody.

Describe the structure of an antibody.

- Y-shaped. Two '**light chains**' bonded to two longer '**heavy chains**' by disulfide bridges
- **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 destroy pathogens?

How do antibodies destroy pathogens?

- Agglutinins form antigen-antibody complexes to enhance phagocytosis (pathogens clump, engulfing occurs more efficiently)
- Bind to foreign cells and attract ‘complement’, a collection of proteins which form pores in the cell surface membrane of pathogens, destroying them
- Opsonins mark microbes for phagocytosis
- Antitoxins make toxins insoluble via precipitation/neutralisation

Outline the “hybridoma method”.

Outline the “hybridoma method”.

An antigen is injected into a mammal to stimulate clonal expansion of complementary B cells. These B cells are harvested and fused with a myeloma, which can undergo mitosis an indefinite number of times. The hybrid cell line is called a hybridoma.

How can monoclonal antibodies (MAs) be used in diagnosis?

How can monoclonal antibodies (MAs) be used in diagnosis?

MAs for specific antigens can be attached to radioactive markers, allowing for specific cells or proteins to be found in the body (e.g. cancer cells, fibrin fibers to locate blood clot). Also useful in blood typing and tissue matching.

How can monoclonal antibodies (MAs) be used in treatment?

How can monoclonal antibodies (MAs) be used in treatment?

Can bind to certain cells, marking them for destruction. Useful in treatment of cancers and autoimmune diseases.

State an issue with using monoclonal antibodies (MAs) in treatment and how it is overcome.

State an issue with using monoclonal antibodies (MAs) in treatment and how it is overcome.

MAs require multiple treatment rounds. As they are sourced from animals this may trigger an immune response. To overcome this MAs are ‘humanised’ by altering the amino acid sequence to those found within humans.

Compare and contrast passive and active immunity.

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Passive	Active
Both involve antibodies (natural or artificial source)	
No memory cells and 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.

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- **Passive natural** - antibodies in colostrum or transferred across placenta
- **Passive artificial** - anti-venom, needle stick injections
- **Active natural** - humoral response to infection
- **Active artificial** - vaccination

Define vaccination.

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The deliberate exposure of an individual to antigens from a pathogen to provide artificial active immunity.

How do vaccinations that use antigens provide long-lasting immunity?

How do vaccinations that use antigens provide long-lasting immunity?

- Antigens in vaccine trigger primary immune response without infection
- If pathogen is encountered, secondary immune response destroys the pathogen before symptoms develop

How do vaccinations that use antibodies provide short-term immunity?

How do vaccinations that use antibodies provide short-term immunity?

- Antibodies give rapid protection against a harmful microorganism
- Allows time for the development of an active immune response

Why was the smallpox eradication successful?

Why was the smallpox eradication successful?

- Variola virus did not mutate
- Live vaccine - strong immune response, only one dose needed
- Virus incubation period short - infected individuals could be identified more easily
- Vaccine biologically stable - easy to store and administer in tropics

Why has measles not been eradicated?

Why has measles not been eradicated?

Vaccine does not produce a strong response. Many boosters are required which is difficult in countries with strained healthcare systems.

How can vaccination programmes control the spread of infectious disease?

How can vaccination programmes control the spread of infectious disease?

Herd immunity - significant proportion of population is vaccinated so pathogen is less likely to affect a non-immunised individual. Disease cannot spread in immune individuals.

Ring vaccination - all individuals within a radius of a known case are immunised, preventing spread from localised areas.

Boosters - where a vaccine does not induce a strong response, these maintain immunity.