

WJEC (Eduqas) Biology A-level

Topic 3.A - Immunology and disease

Flashcards

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What is a 'pathogenic' organism?



What is a 'pathogenic' organism?

An organism that has the ability to cause damage to a host.



What is an 'infectious' disease?



What is an 'infectious' disease?

Describes a disease that can be transmitted between individuals.



Define carrier.



Define carrier.

An infected individual that is asymptomatic but can spread the disease.



What is the disease reservoir?



What is the disease reservoir?

The environment (host) in which an infectious pathogen is found.



Define endemic.



Define endemic.

A disease that is ever-present in an area.



Define epidemic.



Define epidemic.

A rapid rise in the incidence of a communicable disease at a local or national level.



What is a pandemic?



What is a pandemic?

An epidemic that occurs worldwide, affecting a large number of individuals.



Define vaccination.



Define vaccination.

The deliberate exposure of an individual to non-pathogenic forms, antigens or products of pathogens to provide artificial active immunity.



What is an antibiotic?



What is an antibiotic?

A chemical or compound produced by a living organism that kills or prevents the growth of bacteria.



What is an antigen?



What is an antigen?

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



Define antibodies.



Define antibodies.

Immunoglobulins produced by B-lymphocytes in response to a specific antigen, triggering an immune response.



What are antibiotic-resistant bacteria?



What are antibiotic-resistant bacteria?

Bacteria that mutate to become resistant to an antibiotic, survive and reproduce very rapidly, passing on their antibiotic resistance.



Define vector.



Define vector.

A living or non-living agent that transmits a pathogen between organisms.



What is a toxin?



What is a toxin?

A substance produced by a pathogen that causes damage to its host.



What are antigenic types?



What are antigenic types?

Organisms that possess the same or similar antigens on their surface, e.g. strains of a bacteria.



How are antigenic types usually identified?



How are antigenic types usually identified?

Using antibodies from serum.



What is a host?



What is a host?

The organism from which a pathogen or parasite obtains nutrients and/or shelter.



Give some examples of bacterial infections.



Give some examples of bacterial infections.

- Cholera
- Tuberculosis



What is cholera?



What is cholera?

A disease caused by strains of the Gram negative bacterium, *Vibrio cholerae*, the toxins of which cause severe diarrhoea leading to dehydration.



How is cholera spread?



How is cholera spread?

- Fecal/oral transmission
- Ingesting contaminated food or water



How is cholera treated?



How is cholera treated?

- Rehydration (fluid and electrolytes)
- Antibiotics



What is tuberculosis?



What is tuberculosis?

A bacterial disease, caused by *Mycobacterium tuberculosis* and *M. bovis*, that damages lymph nodes in the lungs and neck, and weakens the immune system.



How is tuberculosis transmitted?



How is tuberculosis transmitted?

Airborne droplet transmission



Describe the methods of tuberculosis prevention and treatment.



Describe the methods of tuberculosis prevention and treatment.

- **Prevention** - BCG vaccination of children
- **Treatment** - extensive course of antibiotics



Give some examples of viral infections.



Give some examples of viral infections.

- Influenza
- Smallpox



How is the influenza virus transmitted?



How is the influenza virus transmitted?

- Droplet infection
- Contact with contaminated surfaces



What tissue is affected by influenza?



What tissue is affected by influenza?

Upper respiratory tract



Describe the symptoms of influenza.



Describe the symptoms of influenza.

Headache, coughing and sneezing, sore throat, vomiting, fever, muscular and joint pain.

May cause secondary bacterial infections.



How is influenza treated?



How is influenza treated?

- Quarantine
- Antiviral medication
- Antibiotics treat secondary bacterial infections
- Management of symptoms, e.g. painkillers



What is smallpox?



What is smallpox?

A disease caused by the virus *Variola major* that affects the skin and multiple other organs.



How is smallpox spread?



How is smallpox spread?

- Droplet transmission
- Bodily fluids



Describe the symptoms of smallpox.



Describe the symptoms of smallpox.

Symptoms include a headache, fever and pockmarking of the skin.



Describe how smallpox has been eradicated.



Describe how smallpox has been eradicated.

Due to a successful vaccination program.



What properties of the smallpox virus made its eradication possible?



What properties of the smallpox virus made its eradication possible?

- Little variation in antigens
- Low rate of antigenic mutation
- Immunogenic nature of antigens
- No animal reservoir



Give an example of a protoctistan infection.



Give an example of a protoctistan infection.

Malaria



Name the malarial parasite.



Name the malarial parasite.

Plasmodium spp.



Outline the mode of transmission and infection of the *Plasmodium spp.* parasite.



Outline the mode of transmission and infection of the *Plasmodium spp.* parasite.

- Female mosquito acts as vector when it transfers saliva to another organism during feeding
- Parasite reproduces asexually in red blood cells in liver, causing lysis



Describe the effects of malaria on an infected individual.



Describe the effects of malaria on an infected individual.

It causes recurrent episodes of fever and can be fatal.



How is endemic malaria controlled?



How is endemic malaria controlled?

- **Preventing mosquito bites** - mosquito nets, insect repellent
- **Controlling mosquito numbers** - pesticides, chemical treatment of standing water and sewage, introduction of predators for mosquitoes
- **Drug treatment**



What are viruses?



What are viruses?

Non-living infectious agents that invade host cells and take over cell metabolism, replicating within them.



Outline the forms that the pathogenicity of viruses can take.



Outline the forms that the pathogenicity of viruses can take.

- Cell lysis
- Cell transformation
- Production of toxins
- Immune system suppression



What is cell lysis?



What is cell lysis?

- The disruption of cell membranes, destroying the cell
- Virions released



Describe cell transformation.



Describe cell transformation.

Viruses can stimulate healthy cells to become cancerous.



Give an example of a virus that suppresses the immune system of the host.



Give an example of a virus that suppresses the immune system of the host.

HIV



State the two types of antibiotics.



State the two types of antibiotics.

- Bacteriostatic
- Bactericidal



How do bacteriostatic antibiotics work?



How do bacteriostatic antibiotics work?

Prevent bacteria from growing by interfering with processes required for their growth such as metabolism or DNA replication.



What are bactericidal antibiotics?



What are bactericidal antibiotics?

Antibiotics that kill bacteria.



What is a narrow-spectrum antibiotic?



What is a narrow-spectrum antibiotic?

An antibiotic that is only effective against a narrow range of bacteria.



What is a broad-spectrum antibiotic?



What is a broad-spectrum antibiotic?

An antibiotic that targets a wide range of bacteria.



What are bacterial cell walls made up of?



What are bacterial cell walls made up of?

A three-dimensional mesh of peptidoglycan (murein), a polymer of amino acids and sugars.



Define Gram positive bacteria.



Define Gram positive bacteria.

Bacteria that have a **thick peptidoglycan wall** and a **purple** appearance following gram staining.



Define Gram negative bacteria.



Define Gram negative bacteria.

Bacteria that have a **thin peptidoglycan wall** with an outer **lipopolysaccharide** membrane and a **red** appearance following gram staining.



What type of antibiotic is penicillin?



What type of antibiotic is penicillin?

Narrow-spectrum antibiotic



Describe how penicillin affects bacteria.



Describe how penicillin affects bacteria.

- Kills Gram-positive bacteria and damages Gram-negative bacteria
- Prevents the formation of cross-links between molecules in the peptidoglycan wall, so when osmotic changes occur, the cell undergoes lysis



How does penicillin prevent the formation of cross-links in the peptidoglycan wall?



How does penicillin prevent the formation of cross-links in the peptidoglycan wall?

- Transpeptidase catalyses the formation of cross-links in the peptidoglycan wall
- Penicillin is a competitive inhibitor of transpeptidase



Why doesn't penicillin kill Gram-negative bacteria?



Why doesn't penicillin kill Gram-negative bacteria?

Gram-negative bacteria do not completely lose their cell walls due to the presence of an outer lipopolysaccharide membrane.



What type of antibiotic is tetracycline?



What type of antibiotic is tetracycline?

Broad-spectrum antibiotic



Describe the effect of tetracycline on bacteria.



Describe the effect of tetracycline on bacteria.

- Inhibits translation during protein synthesis
- Competitive inhibitor of an anticodon-binding site on the 30S ribosomal subunits, preventing the formation of new proteins



Why do antibiotics not affect viruses?



Why do antibiotics not affect viruses?

Viruses do not have metabolic pathways.



Why are some bacteria resistant to treatment by antibiotics?



Why are some bacteria resistant to treatment by antibiotics?

1. Random genetic **mutation**, often on plasmid, confers **resistance**, e.g. antigen shape changes
2. These bacteria have **selective advantage** in the presence of antibiotics, reproduce and pass allele for resistance to offspring
3. **Directional selection** results in resistant strain



What are natural barriers?



What are natural barriers?

Defences that are always present and are the same for all organisms.



Outline the natural defences in the body that reduce the risk of infection.



Outline the natural defences in the body that reduce the risk of infection.

- **Skin** - protective layer
- **Skin flora** - protection from harmful pathogens, compete with them for nutrients
- **Blood clotting** - seals wounds
- **Lysozymes** - tears, hydrolyse bacterial cell walls
- **Hydrochloric acid** - stomach, kills bacteria
- **Mucous membranes** - trap pathogens and may secrete antimicrobial enzymes
- **Phagocytosis** - destroys pathogens
- **Inflammation** - localises and eliminates the cause of injury



Describe the specific immune response.



Describe the specific immune response.

- Second line of defense against pathogens triggered by foreign antigens
- Two types: **humoral** immune response and **cell-mediated** immune response.



What are T lymphocytes?



What are T lymphocytes?

Lymphocytes that mature in the thymus gland.



What are B lymphocytes?



What are B lymphocytes?

Lymphocytes that are produced in the bone marrow and mature in the spleen and lymph nodes.



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.

Three main types of T lymphocytes produced:

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



Explain the role of antigen-presenting cells.



Explain the role of antigen-presenting cells.

- Macrophage displays antigen from pathogen on its surface (after hydrolysis in phagocytosis)
- Enhances recognition by T helper cells, which cannot directly interface with pathogens/antigens in body fluid
- Secrete cytokines that are involved in stimulating specific immune response



What are T effector cells?



What are T effector cells?

- T killer cells or cytotoxic T lymphocytes
- Causes lysis of damaged or infected cells



Describe the role of T helper cells.



Describe the role of T helper cells.

- Regulate the immune response through the release of cytokines
- Cytokines stimulate the proliferation of B lymphocytes



Describe the role of T memory cells.



Describe the role of T memory cells.

Remain in the blood and provide immunological memory.



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



Describe the structure of an antibody.



Describe the structure of an antibody.

- Y-shaped
- Two '**light chains**' bonded to two longer '**heavy chains**'
- Two binding sites
- Specific to a particular antigen



Compare the primary and secondary immune responses.



Compare the primary and secondary immune responses.

- **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 happening during the latent period of the primary immune response?



What is happening during the latent period of the primary immune response?

- Antigen-presenting cells carrying out phagocytosis
- T helper cells detect antigens and secrete cytokines
- Proliferation and differentiation of specific B and T cells



Define active immunity.



Define active immunity.

Resistance in an organism that has developed through the **production of specific antibodies** in response to a pathogen. It provides **long-lasting immunity** as memory cells are produced.



What are the two types of active immunity?



What are the two types of active immunity?

- **Natural active immunity** - production of antibodies by the immune system following infection
- **Artificial active immunity** - production of antibodies by the immune system following the exposure to a weakened, attenuated or dead pathogen



Give an example of artificial active immunity.



Give an example of artificial active immunity.

Vaccination against rubella.



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



Define passive immunity.



Define passive immunity.

Resistance in an organism acquired via the **transfer** of antibodies. It provides **short-term immunity** as no memory cells are produced.



What are the two types of passive immunity?



What are the two types of passive immunity?

- **Natural passive immunity** - immunity acquired by an infant mammal when antibodies are transferred through the placenta and the colostrum from the mother
- **Artificial passive immunity** - immunity acquired from the administration of specific antibodies from another organism



Give an example of artificial passive immunity.



Give an example of artificial passive immunity.

Treatment of rabies.



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



Describe the different levels of effectiveness of vaccination programmes against different diseases.



Describe the different levels of effectiveness of vaccination programmes against different diseases.

- **Single round** of vaccinations protects against pathogens that have **low levels** of antigenic variation/mutation, e.g. Rubella
- **Repeated vaccinations** used against pathogens that have various antigenic types and mutate frequently, e.g. Influenza



Outline the ethical considerations that must be considered when designing vaccination programmes.



Outline the ethical considerations that must be considered when designing vaccination programmes.

- **Cost** of developing the vaccine
- **Effectiveness** of the vaccine
- Rights of the **individual** vs rights of the entire **population** to be protected
- Possible **side effects**
- **Religious concerns**
- Testing on **animals** and **unaffected** individuals

