

The Immune Response

- Some important tissues have permanent populations of macrophages help prevent infection
- The lymphatic system is made up of several important organs (spleen, lymph nodes) and the fluid that connects them (lymph)
- Fixed macrophages reside in these tissues and filter out microorganisms and foreign invaders that enter the blood

- Invaders in the body activate antimicrobial plasma proteins, called complement proteins
- There are about 20 known types of complement proteins, which are in their inactive form under normal conditions
- Marker proteins from invading microbes activate the complement proteins, which proceed with several different methods of attack
 1. Some form a protective coating around the invader, immobilizing it (shown in Fig.2a, p. 467)
 2. Some puncture the cell membrane, allowing water to enter and causing the cell to burst (Fig. 2b)
 3. Some attach to the invader, making the microbe less soluble and more attractive to leukocytes (Fig. 2c)

- Another group of WBCs, called lymphocytes, produces antibodies
- Antibodies are protein molecules that protect the body from invaders
- All cells have special markers on their cell membranes, but the immune system does not react to the body's own markers
- Foreign particles activate the production of antibodies
- The cell membrane of a bacterium and the outer coat of a virus contain many different antigens
- The antigen may be a toxin produced by moulds, bacteria or algae
- These toxins interfere with normal cell metabolism

- Two different types of lymphocytes are found in the immune system
- T cells are produced in the bone marrow and stored in the thymus gland
- The T cells seek out the intruder and signal the attack
- Some T cells identify the invader by its antigen markers (Fig.3, p. 467) which are located on the cell membrane
- Once the antigen is identified, another T cell passes this information on to the antibody producing B cell
- B cells multiply and produce antibodies which act as chemical weapons

Antigen-Antibody Reactions

- Antibodies are Y-shaped proteins engineered to target foreign invaders
- Antibodies are specific; an antibody produced against the influenza virus is only effective against that strain of influenza
- The tails of the proteins are similar, differentiation occurs in the edge of each arm, the area which bonds to the antigen (see Fig.4, p. 468)

- Each antibody has a shape that is complementary to its specific antigen
- The cell membrane of a protein or virus has many antigen markers
- The more antibodies attach to these antigens increases the size of the antigen-antibody complex, making it more easily noticed and engulfed
- Specialized receptor sites are found on different cells, which explains why different poisons affect different systems
- The receptor is designed to accommodate either a hormone or a specific nutrient
- If a poison has a similar shape to the natural binding molecule, it will fit into the receptor and enter the cell - causing damage or illness
- Antibodies bind to the toxins, preventing them from binding to the receptors (see Fig.5, p.468)
- Viruses also use receptor sites as entry ports - the DNA enters the cell, but the protein coat remains in the receptor site
- This explains why viruses only invade specific types of cells within one organism (ex/cold viruses only invade cells of the upper respiratory tract)
- In the case of HIV, the virus attacks the receptor sites of the T cell, hiding in the very cell that is responsible for identifying invaders (see Fig.6, p.468)

How the body recognizes harmful antigens (see Fig.7, p.468)

- T cells scout the body in search of foreign invaders
- The macrophages attack invaders and destroy them, but this doesn't destroy the antigen markers, they are pushed toward the cell membrane of the macrophage
- Pressing the antigens into its cell membrane, the macrophage couples with the T cells (aka helper T cells)
- The T cells read the antigen's shape and release a chemical messenger called lymphokine
- This causes the B cells to divide into identical cells called clones
- A second message is sent from the helper T cells to the B cells, triggering the production of antibodies
- Each B cell produces a specific type of antibody
- By the time the B cells enter the circulatory system, many antibodies are attached to their cell membranes
- The helper T cells activate the killer T cells, these lymphocytes carry out search-and-destroy missions (see
- They puncture the cell membrane of the intruder unless it is a virus, because they are inside host cell
- Once the viral coat is found attached to the cell's membrane, the T cell attacks the infected cell, preventing the virus from reproducing
- Killer T cells also destroy mutated cells (see Fig.8, p.470), helping prevent cancer - many experts believe that the most important factor in determining who gets cancer is the success of killer T cells

- Killer T cells also recognize foreign antigen markers on the cells of donated organs, and initiate an assault
- Immunosuppressant drugs slow the killer T cells, preventing rejection but opening the body up to infection
- Negative feedback is initiated by suppressor T cells, which signal the immune system to shut down once the invader has been fought

The Immune System's Memory

- Remember that helper T cells read a blueprint of the invader before B cells produce antibodies
- This blueprint is stored even after the invader is destroyed so that any subsequent infections can be destroyed quickly (this is what we call immunity)
- A memory B cell is generated during the infection, holding an imprint of the antigen
- As long as the memory B cell survives, the person will not become infected by the same invader again

Homework

Read p. 471 "Matching Tissues for Organ Transplant" and "Stem Cell Research"
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