Anatomy and Physiology

9. The Immune System

Immune System

Tour of the System

By taking an imaginary tour of the Immune System, we'll get a better idea of how it works and what it does.

When a virus invades the body, it first attacks a single cell. From there, the virus copies itself repeatedly until much of the body is affected--and INfected.

This is where the Immune System takes action. First, it sends a spy known as a macrophage. The macrophage figures out that the virus is an enemy and does not belong. After the tiny spy moves toward the virus, it devours it, shredding it.

The macrophage next displays antigens on its surface. Antigens are just tiny fragments of the virus. This macrophage could continue seeking out the original virus's offspring, but it would take too long. Instead, it goes for help. This help comes from a T Cell. Specifically, the macrophage finds T cells that recognize fragments from the virus on the surface of the macrophage. When the macrophage meets a T cell and the T cell recog-nizes traces of the virus on its surface, the T cell and macrophage physically unite.

This connecting of the cells creates a chain reaction that leads to the destruction of all copies of the virus inside the body.

How did this happen? When the T cell and macrophage connected, they released chemi-cals which stimulate production of more helper T cells and more macrophages. Even better, they stimulate production of a "killer" T cell.

This new killer T cell tracks down and attacks cells which are infected by the virus. Meanwhile, as the helper T cells are produced, they send out a chemical message that causes B cells to be produced. These then become plasma cells that flood the invaded body with millions of antibodies – ready to do battle.

These antibodies then track down foreign invaders, but they're more selective than the macrophages are. They are specifically seeking the strain of the virus that started the counter attack. These they flag.

The macrophages then jump in and consume these flagged viruses
If things go well, within a few days, all offspring of the virus, as well as the original virus itself, are eradicated.

Functions

The key functions of the immune system include:

• **Identifying enemies.** Specifically, immune-system cells are looking for viruses and other pathogens that have invaded healthy cells and begin reproducing, damaging the body.

• **Spotting tumors.** In the same way, the immune system is responsible for recognizing tumors in the body and beginning the process of eliminating them.

• **Destroying enemies.** Through a complex system of generating and dispatching helper cells, the immune system flags, recognizes, chases and consumes the pathogens and tumors.

• **Building future immunity.** A helpful fringe benefit is that the body develops future immunity against the virus for future attacks. This happens because of the immune system "flagging" the harmful pathogens – and allowing the immune system to recognize it in future encounters.

Components

White Blood Cells: The main soldiers in the Immune System's war against infection are white blood cells. These include:

• LEUKOCYTES. These cells act independently and are one-cell organisms that move like amoebae. Leukocytes capture pathogens by totally engulfing them.

• LYMPHOCYTES: These white blood cells travel through the person's blood looking for any foreign invader-cells. B-cell lymphocytes target bacteria with antibodies. A variety of lymphocytes known as T cells do the actual fighting.

Antibodies: Antibodies, proteins that resemble a capital "Y," respond to antigens and are produced by the white blood cells. They attach themselves to toxins and disable their signals (chemical actions). They also send out a signal to the rest of the System that this is an invader which needs to be eliminated.

Bone Marrow: The bone marrow generates new white and red blood cells. These cells then enter the blood stream, ready to do battle.

Complement System: Sometimes, germs and invaders will get through the body's natural defenses and barriers, into the blood stream. Here, liquid proteins known as complements are started and attacks the invaders. These proteins float freely within the blood stream, each reacting to a different antigen. The liver is responsible for producing complements.

Interferon: Interferon is the body's main anti-viral defense. Most of the body's cells produce interferon. Interferon's purpose is to allow the cell to send messages to other cells. This message goes something like this: I've been infected by a virus, so start producing the proteins necessary that will keep the virus outside your own structure.

Lymph Nodes: These are filters which trap foreign bodies such as germs. Working with the lymph nodes are lymphocytes, a kind of white blood cells which help the lymph nodes handle germs.

Spleen: The job of the spleen is to filter the blood as it seeks out foreign invader-cells. In addition, the spleen searches for older red cells which need to be replaced.

Thymus: Located between the heart and the breast bone, the thymus is the organ that produces T-cells that are vital for the work of the Immune System

Common Diseases and Disorders

There are three common disorders of the Immune System, described below.

Immunodeficiency are the best known, thanks largely to Human Immunodeficiency Virus (HIV, the virus that causes AIDS). An immunodeficiency occurs when certain components of the person's immune system become inactive.

Although we usually think of HIV when we think of immunodeficiency, in reality, it's common for the elderly person's immune system to start declining in their later years – a type of immunodeficiency.

Autoimmunity is the term for when the body's immune system doesn't correctly distinguish between non-self and self – and thus attacks part of the person's own body. Normally, antibodies and T cells respond with what is called "self" peptides. With autoimmunity, this process is disrupted.

Hypersensitivity is a response of the immune system which damages tissues in one's own body. There are four classes of hypersensitivity. Type 1 is an immediate reaction that we usually associate with allergy. Type 2 happens when antigens and antibodies bind together on the person's own cells, and thus marks them for destruction. Type 3 is triggered when aggregations of antigens, IgG and IgM antibodies and complements are deposited in specific tissues.

And type 4, which takes 2 or 3 days to develop, are involved in infectious diseases but can also involve skin contact (Poison Ivy is an example).. Reactions can be helped by monocytes, T cells and macrophages. [18]

Medical Terminology

Antibodies: Refers to a blood protein which is manufactured in the body as a respond to a specific antigen that has invaded the cells.
B-cells: More specifically, a B lymphocyte is one that derives from bone marrow to provide the body with humoral immunity. The B cell recognizes an antigen and transforms into plasma cells which are capable of inactivating the antigens.
Basophils: These are white blood cells that are involved with certain inflammatory reactions, especially those associated with allergies and asthma.
Bone Marrow: Found within the bones, this is fatty connective tissue that can produce the white blood cells that the immune system needs.
Complement system: This system within the immune system is made of about 30 proteins, working together to destroy infectious microorganisms. It does this by causing the bursting of foreign organisms within infected cells.
Helper T-cells: This is a T cell which recognizes antigens on the cell surface that has become infected by a virus. The helper T cell then secretes lymphokines responsible for stimulating B cells as well as killer T cells.
Interferon: A protein which is released as a response to a virus invading the body.
Killer T-cells: These are T cells that have CD8 receptors which recognize antigens on a virus-infected cell surface.

Lymphocyte: This is a kind of white blood cell that has one single round nucleus; it occurs in a person's lymphatic system.
Macrophages: These are large phagocytic cells in tissues in stationary form or, at locations of infection, found as mobile white blood cells.
Monocytes: These are large phagocytic white cells that have simple oval nuclei plus a gray, clear cytoplasm.
Natural killer cells: These are lymphocytes which are capable of binding to virus-infected cells and tumor cells without antigens stimulating them. Once attached to the virus or tumor, they kill these invaders.
Neutrophils: These are a kind of white blood cells that are usually formed in the human bone marrow and are capable of phagocytosis.
Phagocytes: These are a kind of cell that are able to engulf and then absorb bacteria and small, harmful cells.
Plasma cells: These are B cells which manufacture one type of antibody.
Spleen: The spleen is the organ located within the abdomen that's involved in producing and removing blood cells. This vital organ is part of the immune system and is responsible for manufacturing cells that help eliminate infection, and getting rid of the infected cells.
Suppressor T-cells: The suppressor T cell suppresses or reduces an immune-system response of other T cells or of other T cells to the presence of an antigen.
T-cells: T-cells are tiny lymphocytes that are manufactured in the thymus. T-cells organize the immune system in its response to malignant or infected cells.
Thymus: The thymus is the lymphoid organ found in the neck responsible for producing many of the immune system's T-cells.

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