**An Introduction to Immunology**

**Introduction**

The Human body is composed of eleven major organ systems that perform specific and vital operations that aid in the proper functioning of the human body. These systems include: the circulatory, digestive, respiratory, excretory, nervous, and endocrine, integumentary, skeletal, muscle, reproductive, and the immune system. Every single day the human body is exposed to various microorganisms and many of which may even cause disease or damage. The immune system is responsible for killing these microorganisms and fighting off infection. The immune system is an important system that involves various components that prevents and protect against disease. Bacteria that enters the body, passes through various aspects of the immune system. Bacteria that are successful in bypassing all of the body’s immune defenses then move on to further cause disease and damage to the body.

**The Body’s Defenses**

The body’s very first line of defense includes the body’s physical barriers. These **physical barriers** include the skin, hair, sweat glands, cilia, mucosal surfaces, stomach acid, commensal organisms as well as tears. The skin provides the barrier between the outside world and the inside of the body. The skin maintains a strict barrier between these two environments in order to keep pathogens and bacteria outside of the body. Our hair, those on our skin as well as inside of our nose, aid to brush away dust as well as pollutants coming from the outside world. Our sweat glands and sebum function to keep our skin moist; Dry skin can serve as an ideal environment for microorganisms to inhabit. Cilia aligning airways as well as within the lungs function to trap microbes and propel them away from the throat. Our mucosal surfaces are aligned with mucous that aid to trap microorganisms. The acidity of our stomach acid helps to destroy microbes and, last by not least, our microbiome (bacteria that reside within the body which do not normally cause disease) aids in the direct elimination of unwanted pathogenic substances and organisms.

The body’s chemical barriers also contribute to our first line of defense. **Chemical barriers** consist of lysozyme, saliva, sebum, and acidity. Lysozyme is the chemical component that makes up tears and saliva. Lysozyme is used to degrade microbial cell membranes thus eventually resulting in the destruction of the pathogen. Saliva contains lysozyme, which as discussed, functions to destroy pathogens. Sebum helps to keep the skin moist; Moist environments are not ideal locations that pathogenic organisms inhabit. The body’s natural acidity levels within the stomach, genital tract, as well as the mouth aid also aid to eliminate microbes.

If the body’s first line of defense fail, the physical and chemical barriers, the innate immune response comes into play. The **innate immune response** consists of the innate immunity and the adaptive immunity. These two immune responses serve to neutralize and eliminate pathogens. If these two defense systems fail, then death can occur. The components of the innate and adaptive immune responses consist of white blood cells. **White blood cells** are the immune system’s fighter cells; They are deployed to destroy and eliminate foreign microbes as well as microbial substances in order to prevent infection. There are many different types of white blood cells; which are monocytes, lymphocytes and granulocytes. **Monocytes** are progenitors (originators) of the macrophage lineage. **Macrophages** are deployed to sites of infection to battle and engulf foreign disease causing bacteria. **Granulocytes** are the precursor to basophils, eosinophils, neutrophils and mast cells. **Basophils** mediate allergic reactions against allergens. Basophils along with mast cells initiate an inflammatory response to alert our body to the presence of allergens. **Lymphocytes** are the precursors to **T cells** and **B cells**. T cells and B cells two crucial classes of cells in the innate as well as in the adaptive immune response. The main classes of **T cells** are T helper cells and T killer cells. **T Killer cells** also known as cytotoxic T cells act to phagocytize pathogenic bacteria while **T Helper Cells** act to activate other cytotoxic T cells as well as to activate B cells to produce antibodies. The main function of **B cells** is to produce and secrete antibodies against specific antigens. **Antigens** are foreign pathogenic substances and antibodies are produced to bind to and coat the receptors of these antigens. Once antibodies bind to antigen, macrophages are signaled to the area and phagocytize the pathogen.

**Organs of the Immune System**

The organs of the immune system include the bone marrow, the thymus, spleen, lymphatic system, lymph nodes, and lymph. The **bone marrow** is the site of blood cell formation which includes red and white blood cells. **Hematopoiesis** happens in the bone marrow, which is the production of new blood cells. The **thymus** is the site of T cell maturation. T cells originate in the bone marrow and then move to the thymus where they are matured. The **lymphatic system** circulates lymph that is then transported to the body’s major lymph nodes. **Lymphatic** Fluid carries the body’s drainage as well as any harmful bacteria or antigens and circulates it through the body and to lymph nodes. In the **lymph nodes**, harmful bacteria and antigens are met with lymphocytes which are the body’s defense cells that works to eliminate the pathogens.

**Types of Immune Responses**

An **immune response** is the body’s response to a pathogen or antigenic substance. An immune response is initiated by the mediators of the body that detect these harmful substances. An immune response is deployed in an effort to neutralize and eliminate the disease. There are two main immune responses that are initiated and deployed when the body encounters foreign and harmful pathogens, which are the **innate** and the **adaptive immune responses**.

The **innate immune response** serves as the first line of defense when the body encounters a harmful pathogen. The innate immune system consists of the body’s physical and chemical barriers (which were previously discussed). These include the skin, mucous membranes and the body’s normal microbiota. The chemical barriers are also within the innate defense system which include the toxins that are produced by the body’s normal microbiota as well lysozyme that are in the body’s mucosal membranes and in our tears. Other components of the innate immune response include, neutrophils, monocytes, dendritic cells, macrophages and natural killer cells. These cells are activated and go straight to the site of infection to neutralize the pathogen. The innate immune response also aids to promote inflammation which functions to promote vasodilation, increased body temperature and aids in the rush of lymphocytes to areas of infection. The innate response is an immediate and nonspecific response to foreign bacteria that occurs within minutes to hours of detection. The components of the innate immune response detect pathogens and bacteria by cell surface receptors. This immune response has no memory component.

The **adaptive immune response** can become activated and initiated when the innate immune response fails to contain and neutralize the pathogen. It serves as a second line of defense when the first line of defense, the innate immune response, fails. The main function of the adaptive immune response is to identify and neutralize pathogens that bypassed through the innate immune defenses. The components of the innate immune responses include Killer T Cells, Helper T Cells, B Cells, and antibodies. Killer T cells are activated by helper T cells and function to go to sites of infection and neutralize pathogens. Helper T Cells release cytokines that aid in the regulation of the immune response. They also aid to activate cytotoxic T cells and macrophages as well as help to stimulate B cells to secrete antibodies. B cells are plasma cells that secrete antibodies. **Antibodies** are Y shaped with a variable region and a constant region as well as two heavy and two light chains. Antibodies bind to specific regions on pathogens which work to neutralize the pathogen.

The innate and adaptive immune response work together in three ways: opsonization, complement activation and cytokine secretion. **Opsonization** is the process of antibodies coating microbes. When these microbial organisms are coated with antibodies, macrophages then work to phagocytize, that is to engulf and destroy the bacteria. **Complement** are a series of serum proteins that function in the innate and specific immune responses. The **complement** **system** kills microbes in three different ways: opsonization, inflammation, and cytolysis. The complement system is composed of about thirty serum proteins that are activated through a series of cleavage reactions. **Cytokines** are secreted by Helper T cells that function to activate macrophages of the innate immune response. Together the innate and adaptive immune response works to neutralize and destroy all foreign pathogens that into the body.

**Conclusion**

The immune system is a vital component to all humans and without its proper functioning we would not be able to survive even the smallest of infections. The immune system consists of several components working both independently and together to help kill disease causing bacteria. The immune system employs very complex mechanisms in order to carry out the process of eliminating pathogens. A defect in any of these components, whether it may be caused genetically or by a disease such as HIV, can result in many malfunctions that would disrupt this system. A disruption in the immune system can cause serious damage and which could eventually lead to death. It’s important to maintain a healthy immune system which can be done by adopting a healthy lifestyle and having a diet high in prebiotics and probiotics.

**References**

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