

RBI-205 LECTURE STUDY NOTES BLOOD

VI. IMMUNITY

- A. 1. **Scope**--this will of necessity only be a brief overview of this complex topic, about which new knowledge is being gained rapidly. There is much remaining to be learned, however.
2. **Types**
- a. **Non-specific** -- this does not involve the immune system. Examples – integument; mucous membranes; secretions (e.g. saliva).
- b. **Specific** – this involves the immune system
- B. **Reticuloendothelial system**
1. **Components**--this lymphoreticular or R-E system includes the following:
- Thymus.
 - Lymph nodes.
 - Spleen.
 - Scattered lymphoid tissue
 - Tonsils.
 - Lymphocytes and plasma cells.
 - Sessile (non-mobile) reticulum cells of the liver, bone marrow, and other sinusoidal tissues.
2. **Functions**--this system's collective function is disposal of waste and foreign, that is antigenic, material immunologically or the debris from doing so.
- C. **Immune Responses**
1. **Concepts**—any normal proteins of the body are termed self. Any substance foreign to an individual's body is called an antigen (non-self). Antigens are usually proteins, but can be carbohydrate or a protein-carbohydrate combination (e.g. glycoprotein). Antigens are immunogenic, meaning their presence in the body stimulates immune responses.
2. **Humoral response**¹
- a. **Antibodies**--the response to an antigen involves the production of specific antibodies against it. An antibody against one antigen is seldom effective against another. Antibodies become part of the plasma proteins, called immunoglobulins (gamma globulins).
- b. **B-cells**--antibodies are produced through the auspices of special lymphocytes termed B-cells, which have receptor sites for antigen-binding on their surfaces.

¹Humoral refers to "fluid"; this relates to something being eventually based within the plasma and lymph.

- c. **Plasma cells**--actual antibody synthesis is accomplished by plasma cells which have been influenced by the B-cells.
- d. **Memory B-cells**--these are produced from some plasma cells so that they can remain to produce antibodies if the antigen is encountered in the future.
- e. **Macrophages**--these apparently assist by processing the antigen and by transferring specific information to the lymphocytes. Further, they assist helper T-cells (see cell-mediated response below).
- f. **Methods of antigen destruction**
 - (1) **Rupturing** (lysing) of bacterial cells.
 - (2) **Immobilization**--this is usually chemical.
 - (3) **Clumping** (agglutination) of the target cells.
 - (4) **Stimulating phagocytes**--macrophages and neutrophils, increasing their activity.

3. **Cell-mediated (cellular) response**

- a. **T-cells**--these are specialized lymphocytes from lymph nodes which are activated by an antigen to cause other cells to move to the site of antigen entry.
- b. **Methods of antigen destruction**
 - (1) **Keeping phagocytes** in the area.
 - (2) **Chemotaxis** to attract leukocytes.
 - (3) **Cytotoxins** are produced by cytotoxic T-cells to directly kill invading microorganisms.
- c. **Helper T-cells**--these not only respond as just mentioned, but will stimulate B-cells to begin the process which will result in antibodies. *These cells are actually central in importance for all aspects of immunity*-- this control is exerted chemically via substances termed lymphokines.

D. **Types of Immunity**

1. **Active**

- a. **Natural**--if a disease is contracted, the person's body will produce antibodies and/or cellular immune protection. This does not occur before the often severe effects of the disease, possibly causing death.
- b. **Artificially induced**--many deadly diseases have been conquered by this process, which involves giving persons the antigen (immunization) or part of the actual infectious agent (vaccination). This will then stimulate antibody production. The injection may be one of the following:

> Killed virus--polio (Salk), rabies, influenza, measles, typhoid, bubonic plague.

> Detoxified toxins--diphtheria, tetanus.

> Substitute, less potent organism--cowpox (for smallpox), polio (Sabin).

Immunity thus acquired may last only a few days, month, years, or a lifetime.

2. **Passive**--when no previous immunity exists, antibodies (antitoxins) are injected which have been produced from the serum of another animal (e.g. horses, for snake antivenom) which was actively immunized itself.

3. **Tissue**

a. **Concept**--if the antigen-antibody reaction occurs near tissue cells, rather than free in the blood or tissue fluid, there is a violent reaction which causes cellular destruction, releasing histamine and other substances which cause increased permeability to tissue fluids. This results in pooling of fluids, which over a large enough area would lower cardiac output and lead to fatal shock (called anaphylactic).

b. **Cause**--antibodies are normally free in the body fluids, not near susceptible tissues. Partially formed antibodies stay in the area of their formation, producing this tissue immunity.

c. **Allergies**--hay fever is an allergy against pollen, so the immune reaction occurs in the nasal mucosa, causing swelling and excess fluids. The symptomatic reaction does not have to occur at or near the site of entry, though--e.g. food allergies causing skin eruptions; the mechanisms producing the symptoms are the same as hay fever, though. Treatment of allergies often involves desensitization by repeated exposure (usually via infections) to the specific antigen(s) to which the person is sensitive. The objective is to stimulate the production of normal (fully formed) antibodies which would not be near the site of entry. Later, the quantity of antibody would decrease until finally total desensitization may be achieved; this could take years, however.

4. **Autoimmunity**

a. **Concept**--this is a failure of the mechanism that normally suppresses the production of antibodies against one's own tissues. Antigenic substances, called autoantigens, formed within the body excite formation of antibodies and/or cellular immune responses, and the resulting antigen-antibody reaction causes tissue injury in target organs which contain the autoantigens.

b. **Causes**

(1) **Somatic cell mutation**--a random mutation of a lymphocyte may produce a cell capable of releasing antibodies capable of reacting with normal body tissues (treating them as antigens, that is).

(2) **Inaccessible antigens**--the abnormal release of substances from cloistered areas of the body, where they would not be in contact with the R-E system, would likely lead to their treatment as antigens. Examples are; eye lens

protein; thyroglobulin (form of hormone) from the thyroid gland; and, joints, causing rheumatoid arthritis from the effects.

- (3) ***Cross-reactions***--this involves an antibody attacking a normal body substance closely related chemically to an invading antigen. Heart damage from rheumatic fever is one example, since the invading bacteria resemble certain cardiac muscle proteins.