Resistance and Immunity

Natural Resistance—innate, inborn, or native resistance. Generally this refers to a non-specific resistance.

1. Species resistance-immunological characteristics vary with different species. For example, humans may not be susceptible to certain strains of the flu virus, while birds may become sickened with that particular strain. Humans can get anthrax, while frogs do not. These differences amongst species are attributable to variations in anatomy, physiology, nutritional state etc.

2. Sub-groups within a given species display variations in resistance-immunological characteristics vary with sub-groups. This is driven by evolution. For example, in areas of the world where malaria is prevalent, we find increased incidences of sickle cell anemia. Red blood cells in those suffering from sickle cell anemia are less accommodating to the malarial parasite. This condition favors the survival of those who contract malaria.

3. Individual resistance—individuals within a species show variations in their capabilities to fight off disease. This is explained by a variety of factors and can be complicated by allergies, hormonal balance, stress, age and genetic differences. Physical fitness, good nutrition and emotional health can also factor into this. This explains why it is possible that an individual may get sick from the exposure to a particular infectious agent while another who is also exposed may remain healthy.

Defense Mechanisms of the Host

There are 3 lines of defense.

1. First line—a non-specific line of defense consisting of physical barriers, mechanical shedding and chemical/body secretions.

   A. Physical barriers- the unbroken skin; the linings of the G.I. tract, urinary tract, respiratory tract and reproductive tract. These are open to the outside and provide protection as natural barriers.

   B. Mechanical shedding

      1. Mucociliary escalatory system of the respiratory passage. This involves a coordinated action of the cilia in combination with mucus to move dust and debris upward from the trachea and into the laryngopharynx for swallowing.

      2. Coughing, sneezing, flushing with tears, perspiring, salivating, urinating, vomiting and diarrhea are processes which mechanically shed unwanted materials.
C. Chemical/body secretions

1. Lysozyme-breaks down peptidoglycan in bacterial cell walls.

2. Acids-stomach acid @ pH of approximately 2 kills most bacteria. This acid does not destroy the organisms that cause typhoid fever, shigellosis or cholera for example. The polio virus and hepatitis A virus will also survive this acidity. The toxins that cause botulism and Staphylococcal food poisonings are also left untouched by stomach acidity. The pH of the skin ranges from 3 to 5 due to the unsaturated fatty acids in sebum. This deters many microorganisms from growing but provides a suitable environment for the normal skin flora.

3. Saliva-as a secretion, it contains many active ingredients that tend to inhibit microorganisms. Included are lysozyme, lactoperoxidase, thiocyanate and hydrogen peroxide.

2. Second line-a non-specific line of defense that involves the process of phagocytosis. In phagocytosis leukocytes ingest particulate matter that enters the body. The cells involved in this process are the neutrophils (polymorphonuclear leukocytes) and the macrophages. Monocytes that leave the blood become macrophages. Neutrophils are the first phagocytic cells to arrive an infection site. They are involved in acute infections. The macrophages arrive later and are involved in long-term and chronic infections. Macrophages are not only phagocytic in function, but they also play a role in activating the 3rd line of defense. To this end they produce IL-1 which activates T_h lymphocytes. They also gobble up foreign materials, process their antigens and wear these antigens on their cell surfaces so that they can interact with and activate both T and B lymphocytes. (3rd line of defense-more later). Macrophages are referred to as fixed or wandering. Wandering macrophages move about and do not take on a specific name. Fixed macrophages stay in a particular location and become named. For example, a histiocyte is a fixed (tissue) macrophage. Kupffer cells are fixed macrophages in the liver. Macrophages in the lung are alveolar macrophages.

A. Mechanism of phagocytosis

1. Mobilization-the events associated with the inflammatory response play a major role in bringing phagocytic cells into the appropriate area. Inflammation is characterized by swelling, heat, redness, pain (sometimes loss of function). It is triggered by tissue damage or the presence of foreign particles or chemicals. Cells involved with the inflammatory response release histamine, kinins and prostaglandins. This causes local vasodilation and increased capillary permeability. This brings more phagocytic cells into the area and also allows these cells to exit the capillaries and move into the tissue spaces. Damaged cells also release leukotaxine. Leukotaxine facilitates chemotaxis. In chemotaxis chemicals attract neutrophils and monocytes to the area. The phagocytic cells then undergo the processes of margination and diapedesis.